HOLMES' SYSTEM

SURGERY.

VOLUME II.

A

SYSTEM OF SURGERY,

THEORETICAL AND PRACTICAL.

IN

TREATISES BY VARIOUS AUTHORS.

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THOROUGHLY REVISED AND MUCH ENLARGED.

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ASSISTED BY

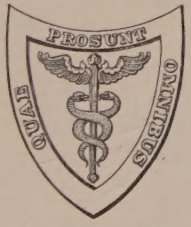
A LARGE CORPS OF THE MOST EMINENT AMERICAN SURGEONS.

IN THREE VOLUMES,

WITH MANY ILLUSTRATIONS.

VOL. II.

DISEASES OF ORGANS OF SPECIAL SENSE. DISEASES OF CIRCULATORY SYSTEM. DISEASES OF DIGESTIVE TRACT. DISEASES OF GENITO-URINARY ORGANS.



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PART I.

DISEASES OF ORGANS OF SPECIAL SENSE.

EYE.

EAR.

NOSE.

TONGUE.

A SYSTEM OF SURGERY.

PART I.

DISEASES OF ORGANS OF SPECIAL SENSE.

DISEASES OF THE EYE.

By James Dixon, M.D.

Revised by George C. Harlan, M.D.

CHAPTER I.

OPTICAL DEFECTS.

Emmetropia (Refraction and Accommodation).—Ametropia (Myopia, Hypermetropia, Presbyopia, Astigmatism).

Assuming the reader to be acquainted with the general laws of optics, I may begin by saying a few words about the eye as an optical instrument; and may then briefly describe those defects in its refraction and accommodation which interfere with the perfect performance of its functions.

The terms Emmetropia and Ametropia[1] have been invented by Donders to designate the normal and abnormal state of the eye in respect of its refractive phenomena. An eye of perfectly normal refraction, in which parallel rays of light meet in a focus on the retina, Donders calls emmetropic—*Emmetropia* implying "sight within due measure" (Ἔμμετρος, within measure, and ὄπια, the terminal modification of ὄψ, sight). An eye in which parallel rays come to a focus either in front of or behind the retina, he calls *ametropic* (ἀ and μετρωπία).

Although we familiarly speak of the rays of light that come to us from distant objects as being parallel to each other, yet, strictly speaking, all luminous rays pass off from their source *divergently*. It is obvious, however, that the divergence of any rays falling on the eye must become less in proportion as their source is removed farther off; so that by the time the rays from a distant object are passing through the small aperture of the pupil, their divergence has become so trifling that, for all practical purposes, they may be regarded as parallel.

In considering the eye as an optical instrument, we have to do only with those rays of light which are admitted by the pupil—they alone being concerned in vision.

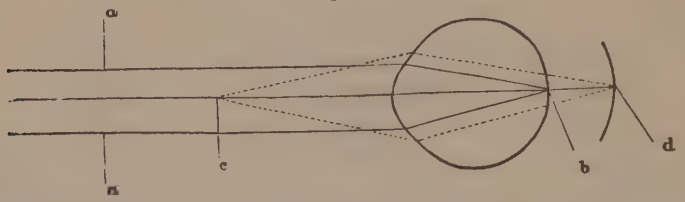
While in a perfectly formed, and normally refractive, or emmetropic eye, the rays from distant objects would naturally come to a focus upon the retina, and there form a picture which is to be recognized by the sensorium, the rays from near objects, falling on the surface of the cornea in a state of more or less divergence, would, in passing on through the refractive media of the organ, tend towards a focus behind the retina. (Fig. 246).

[1] The generic term *Ametropia* is seldom employed, inasmuch as that special form of it which happens to be immediately under observation, leads one to use the terms *Myopia*, *Hypermetropia*, or *Presbyopia*. But were the word "Ametropia" often pronounced by Englishmen, it would be constantly liable to be mistaken for "Emmetropia," its direct opposite, in consequence of the peculiar sound of our close *a*. On the Continent, where the *a* has uniformly its broad open sound (as in *father*), this confusion cannot occur. Our strictly English eccentricity might have been indulged, while at the same time the distinction between the two generic terms would have been made even more marked, if *Eemetropia* had been chosen as the converse of *Emmetropia*. [The term *Ametropia* is now in universal use.]

To effect near vision, therefore, it becomes necessary that the media should undergo such a change as will bring divergent rays to an exact focus on the retinal surface. This change is the result of an active effort which is called *Accommodation.*

Various theories have at different times been suggested to explain the mechanism of this act of adjustment or accommoda-

Fig. 246.



Emmetropic eye in a state of rest. Parallel rays, *a, a*, come to a focus on the retina at *b*. Rays from a near object, *c*, being divergent, tend toward a focus behind the retina *d*. The act of accommodation, which consists in increased convexity of the lens, causes these divergent rays to converge to a focus at *b*.

tion of the eye to near objects. First, it was said that by a contraction of the recti muscles the eyeball was compressed on all sides, and thereby elongated in its antero-posterior diameter, and thus the retina was actually removed backwards into such a position as enabled it to receive upon its surface the exact focus of the rays. Secondly, according to another theory, the act of accommodation consisted in an increased curvature of the cornea. This Home and Ramsden considered themselves to have proved by conclusive experiments. Thirdly, it was maintained that the lens was moved bodily forwards.[1]

All of the foregoing theories of accommodation are evidently fallacious. 1. In a case of total paralysis of the third, fourth, and sixth nerves, all the ocular muscles are inert, and yet the patient's vision of near objects remains totally unimpaired.[2] 2. The curvature of the cornea has been carefully tested, and found not to vary during the act of accommodation. 3. No apparatus exists adequate to move the entire lens forward to an extent sufficient for the purpose of accommodation. During the performance of the delicate experiments I am about to allude to, no change in the position of the entire lens could be detected. 4. An increase in the convexity of the lens, especially of its anterior surface, is now universally accepted as the cause of the eye being accommodated to near objects.[1] Theoretically such a change of form will account for the attainment of the end in view; and practically it has been found, by carefully watching the alteration in the reflected images of a flame held in front of the eye, that, while the reflection from the surface of the cornea remains totally unchanged during the act of accommodation, the images reflected from the anterior and posterior faces of the lens (Purkinje's[2] images they are termed) change both their size and relative position.

[1] This movement was effected, according to Porterfield, by a contraction of the ciliary processes; or, as he termed them collectively, the *ligamentum ciliare*. Porterfield, however, knew nothing of the existence of what is now called the "ciliary muscle." (See his Treatise on the Eye, etc., 1759, vol. ii., p. 4.)

[2] [A *total* paralysis of the third nerve includes the branch distributed to the ciliary muscle, and suspends all power of accommodation. The ciliary muscle may, however, remain unaffected when all the external muscles of the ball are paralyzed.]

[1] This theory was first published by Young in 1793; but along with it he brought forward the mistaken notion that the change in the shape of the lens was owing to its possessing an inherent power of contraction, due to its being wholly made up of muscular fibres and tendons. This anatomical error had been previously advanced by Pemberton, in 1719. In 1796 Young retracted the theory he had brought forward three years before, declaring it to be "neither new nor true," and accepted the change of curvature in the cornea as the efficient cause of accommodation. At a later period (1800), while he abandoned the opinion that the lens was muscular, he still maintained that it possessed within itself a power of changing its form, and that by increasing its convexity, it adapted the eye to near objects. (Phil. Trans., 1801.)

[2] The following is Purkinje's experiment, which, before the invention of the ophthalmoscope, was frequently employed as a "catoptric test" of the presence of incipient cataract. The patient, with his pupil dilated, is placed in the dark, and a lighted taper is then held on a level with, and at a few inches from the pupil. Three images of the flame are then perceived; one, large, distinct, and upright, is reflected from the cornea; two others, much smaller than the corneal one, appear within the pupil. Of these deeper images, one, inverted, is reflected from the

The ciliary muscle is now generally believed to be the active agent in changing the shape of the lens during accommodation, but the precise mode in which the process is effected is not easy to explain. The iris also seems in some way to aid the ciliary muscle, but that the iris is not the chief agent in accommodation is proved by the fact that, in cases where it is absent from birth (*Irideremia*), or where it has been removed from the eye by an accident, accommodation seems but little impaired.

The temporary loss of accommodation in persons who have severely suffered from diphtheria illustrates the dependency of the function on some form of muscular action. In such patients, long after all their acute throat-symptoms have passed away, and they are resuming their ordinary employments, a remarkable weakness in some of the small muscles of the body becomes manifest; the palatal muscles are found to be impaired in their action, and at the same time the power of reading is lost, or it can be exercised only for a few seconds. This defect of vision is not due to any impairment of the optic nerve, for a convex glass held in front of the eye at once compensates for the loss of accommodating power, and enables the patient to read clearly.

Near and far points of distinct vision.—There is a limited range within which small objects, printing-types, for instance, can be distinctly seen by a healthy, or emmetropic, eye. If they are brought nearer to the eye than a certain point, they can no longer be recognized. This is called the "near point of distinct vision." If the types be moved farther off, they can still be read until they have receded to a certain distance, when they again become indistinguishable. The space comprised between these two points is called the "range of accommodation."

[The range of accommodation is the distance between the near and far points of distinct vision, and is expressed by the power of the convex lens which would accomplish the change in refraction necessary to adapt the focus of the eye from the far point to the near point. In emmetropia and hypermetropia, the distance of the far point is infinite, but in myopia it is limited. The following is Donders' formula: $\frac{1}{A}=\frac{1}{P}-\frac{1}{R}$, in which $\frac{1}{A}$ is the range of accommodation. P is the distance (in inches) of the near point, and R the distance of the far point. A person who has normal vision beyond 20 feet, and can read fine print at 6 inches, has $\frac{1}{A}=\frac{1}{6}-\frac{1}{\infty}=\frac{1}{6}$. A person with a myopia of $\frac{1}{24}$, who cannot read nearer than 6 inches, has $\frac{1}{A}=\frac{1}{6}-\frac{1}{24}=\frac{1}{8}$.]

The *far point* in an emmetropic eye is said to be "at an infinite distance." That is to say, rays of light from the most distant objects, the stars for instance, come to a focus upon the retina while the eye is in a state of rest. It is evident that if we use "infinite" in its strictly etymological sense, no two things can be at an infinite distance from each other. The word, however, is technically applied to rays which, being inappreciably divergent, are therefore treated of as if really parallel; not only such as come to us from one of the heavenly bodies, but even from an object several yards off. As some distance must be assigned respectively limiting the bounds of finite and infinite rays, twenty feet is commonly spoken of as the distance by ophthalmic writers; appreciably divergent rays, coming to the eye from an object less than twenty feet distant being called "finite," and those from all objects beyond that distance "infinite."

Ametropia.—The chief forms of ametropia are those popularly known as "short-sight," and "long-sight." The latter, in its true meaning, will come to be considered under the term presbyopia; but there is another form, the clear discrimination of which we owe to Donders; and to which he has given the name of "Hypermetropia." It is a very common affection, depending on original malformation of the eyeball, and affecting therefore persons of all ages. In short-sight (*Myopia*), parallel rays such as pass to the eye from a distant object, come to a focus in front of the retina; in Hypermetropia the rays tend to a focus behind the retina.

On the same principle of terminology which induced Donders to name this defect Hypermetropia—the sight being, as it were, *ὑπέρμετρος*, above the measure—short sight would be called *Hypometropia* (*ὑπομετρος*, below the measure); but Donders has chosen to retain the name "Myopia" for two reasons: first, because the word is established and universally accepted; and, secondly, because the similarity of sound between "hypo" and "hyper" would be apt to cause confusion and misunderstanding.

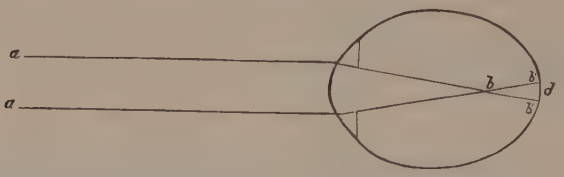
In *Myopia* (Fig. 247) the eye is adapted

hinder face of the lens; the other, upright, from its front surface. If the taper be now slowly moved from side to side, the inverted image, which is always ill-defined, quits its position between the two upright images reflected from the cornea, and from the front of the lens, and glides away in a direction opposite to that in which the taper is moved.

for bringing divergent rays to a focus on the retina; but parallel rays come to a focus in front of it, and then, again diverging, pass on to form upon its surface what are called "circles of dispersion," and thus an ill-defined image of a distant object is produced.

A concave glass, of a curvature proportioned to the degree of myopia, held in front of the eye, causes parallel rays to di-

Fig. 247.

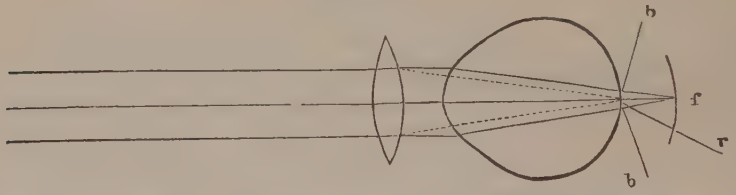


Myopic eye: too long in its antero-posterior diameter. Parallel rays, before reaching the retina, come to a focus at *b*; then crossing, they form on the retina circles of dispersion at *b'*, *b'*.

verge before entering the pupil, and they are then reunited, and brought to a focus exactly upon the retinal surface (*d*). The cause of myopia consists either in the media of the eye, especially the lens, being too highly refractive, or in the eyeball itself being too long from before to behind. [Careful measurement in a large number of cases has shown the corneal refraction rather below the average in myopia. Myopia due to increased refraction of the lens is spasmodic. True, or "axial" myopia depends always on the shape of the ball.] This elongated, ovoid form of the eye is best seen when the patient forcibly adducts it.[1]

In *Hypermetropia* (Fig. 248) the parallel or quasi-parallel rays from distant objects tend towards a focus behind the retina, while the divergent rays from near objects cannot be brought to a focus on the retina until, by artificial means, they have been made to converge. A hypermetropic patient, therefore, sees neither distant nor near things distinctly [except in so far as the hypermetropia may be neutralized by the act of accommodation. Young people usually have the power of doing this in a very high degree. The hypermetropia that is thus neutralized or concealed by increasing the convexity of the lens is called *latent;* what remains not-

Fig. 248.



Hypermetropic eye; too short in its antero-posterior diameter. Parallel rays, tending towards a focus at *f*, form on the retina circles of dispersion at *b*, *b*. Divergent rays would tend towards a focus still more distant.

withstanding the action of the ciliary muscle is called *manifest;* while the whole amount, as shown by paralysis of the ciliary muscle or complete atropinization, is the *total hypermetropia.* Thus distant vision, instead of being a state of rest, requires a certain amount of accommodative effort, which for near vision must be added to that used by an emmetropic eye.] Hypermetropia is caused either by the eyeball being too short from before to behind (Fig. 248), or by the refraction of its media being too low; or both these conditions may be combined. Convex glasses, of suitable focal length, make both distant and near objects distinct, by causing parallel and divergent rays to converge, and thus bringing them to a focus on the retinal surface.

Presbyopia (πρέσβυς, aged). Persons who originally have had excellent sight, both for distant and near objects (*Emmetropia*), as they advance in life find that, while their distant sight is as acute as ever, near objects become more and more indistinct. Type is held farther and farther from the eyes, as the "near point" recedes. The accommodating power has become impaired, partly by the lens acquiring greater firmness, and therefore being less able to yield to that force which

[1] Porterfield says: "By myopes I understand such as have the cornea and crystalline, or either of them, too convex, or that have the distance betwixt the retina and crystalline too great." A Treatise on the Eye, etc., Edinb., 1759, ii., p. 36.

ought to render it more convex when near objects are looked at; and partly from that force itself becoming weaker. A convex glass, of such a curve as will bring back the receded "near point" to its normal position, at once renders near objects distinct.

Although a presbyopic and a hypermetropic person may both be seen using convex glasses for reading, the state of their vision is very different. The presbyopic person may have been originally emmetropic, his eyes in a state of rest bringing parallel rays to a focus on the retina, and his accommodating power, by changing the form of his lens, serving also to bring to a focus on the retina the divergent rays from near objects.

[A presbyopic person is not necessarily ametropic. Emmetropia refers to refraction only, and an emmetropic eye is one in which parallel rays of light, coming from distant objects, are brought to a focus accurately upon the retina. Presbyopia is simply a diminution of the power of accommodating the eye to near objects by increasing the convexity of the lens. Presbyopia, therefore, renders the assistance of a convex glass necessary in reading, even though the eye may be entirely emmetropic. The age at which presbyopia commences varies with the vigor of the person and the nature of his occupation, but chiefly with the state of his refraction. While hypermetropia hastens its approach, myopia postpones it. In emmetropia, presbyopia usually commences between forty-five and fifty, and is shown by difficulty in reading and writing, or other close work, particularly at night. The idea that the eyes are injured by commencing too early with glasses is a mistaken one. They should be used as soon as it is no longer possible to read comfortably without them, but a low power should be chosen at first; $\frac{1}{7}$ is generally strong enough to commence with.]

In the hypermetropic person, on the contrary, sight was always defective, both for distant and for near objects. On account of its short antero-posterior diameter, the eye, while in a state of rest, could not receive upon the retina parallel rays; they all tended to a focus behind it, while the divergent rays from near objects could not be focussed on the retina until they had artificially been changed into convergent ones.

Presbyopia and hypermetropia, therefore, are the direct contrasts to each other. Even a myopic patient, in advanced age, will sometimes be found to a certain degree presbyopic, in consequence of the failure in accommodation which is induced by increased density in the tissue of the lens.

Astigmatism.[1]—In an eye otherwise perfectly formed the cornea may be unsymmetrical, so as to present different curves accordingly as its anterior surface is measured vertically, transversely, or obliquely. The rays of light, therefore, as they fall on one or other of these meridians of the eyeball, become differently refracted, and cannot all meet at one point or focus.

[The astigmatism due to difference of refraction of the principal meridians of the eye is called *regular astigmatism*, and is the result of a want of symmetry in the surface of the cornea. If rays of light falling on the same meridian are not equally refracted, the defect is called *irregular astigmatism;* it depends upon the distortion of conical cornea or the impairment of the cornea by inflammation or upon a defective crystalline lens, and cannot be corrected by glasses.

Regular astigmatism may be hypermetropic or myopic, and *simple*, *compound*, or *mixed*. In simple astigmatism one meridian is emmetropic and the other hypermetropic or myopic; in compound there is hypermetropia or myopia in both meridians, but a higher degree in one than in the other: in mixed astigmatism there is hypermetropia in one meridian and myopia in the other.]

The researches of Donders and others show that astigmatism, at least in a slight degree, is by no means so uncommon as was formerly supposed. It is best detected by making the patient look at a paper on which are drawn vertical and horizontal lines of equal thickness, and noting which lines become the more clearly defined at a given distance. Young, who was himself affected with astigmatism, was the first to describe this peculiarity of vision.[2] He believed the cause to be in his lens, which he imagined to be placed obliquely to the axis of vision. Airy[3] next published an account of this condition, as affecting one of his own eyes, and he invented a glass of a peculiar form to correct the irregular re-

[1] *Astigmism* would be the more correct term, στιγμή (στιγμῆς), being commonly used by Greek writers to express a geometrical point, while στίγμα (στίγματος), always signifies something material, more or less visible or tangible—a puncture, mark, or spot. I took the liberty of pointing this out to the late eminent scholar, Dr. Whewell, who had originally suggested the word "Astigmatism," and he approved of *Astigmism*, as being etymologically the better-formed word.

[2] In the year 1800; Phil. Trans., 1801.

[3] In 1825; Trans. of the Cambridge Phil. Soc., vol. ii., p. 257. In his second paper, 1846 (Trans., viii., 361), he mentions that Whewell had suggested the name "Astigmatism" to designate the affection.

fraction. Glasses of this kind are now commonly used, under the name of cylindrical or astigmatic glasses. Such a glass must be a segment of a cylinder, the axis of which is then placed before the eye vertically, transversely, or obliquely, according to the meridian of irregular refraction. For a myopic or hypermetropic patient the glass must be concavo-cylindrical or convexo-cylindrical. An instrument for determining the precise direction of the axis of asymmetry has been invented by Laurence.

I may now make a few remarks on some special points in the diagnosis and treatment of Myopia and Hypermetropia.

As I have already observed, a myopic eye is so formed as to be adapted for bringing strongly divergent rays to an exact focus on the retina; and therefore the minutest near objects are often seen with extraordinary clearness of definition, so that a "diamond" type can be read with perfect ease at a distance of four or five inches, although at only double that distance it becomes quite illegible. As soon as the object has been removed beyond the far-point of distinct vision, the rays, after coming to a focus in front of the retina, again diverge, and form upon it the "circles of dispersion" already alluded to. The farther the object is removed from the eye, the larger these circles become; and the patient instinctively brings the edges of his lids close together, as he finds by experience that, by thus cutting off some of the rays which would otherwise enter the pupil, the dimness caused by the circles of dispersion is diminished.

There is an endless variety in the range of accommodation among myopic patients. Some can read the smallest type at a distance of 5 or 6 inches, others only at 2 inches from the cornea. Each case must be examined and judged of by itself, for there are many complications which may prevent our always applying the same unvarying rule for deciding what form of concave glass is required to neutralize the myopia. Commonly, however, we may ascertain what degree of concavity will suit for clear vision of distant objects by noting at how many inches from the cornea a small test-type can be distinctly read, and then giving the patient for distant objects a concave glass of corresponding focal length. Thus a patient who with the naked eye can define the test-type only at five inches is said to be myopic $\frac{1}{5}$, and a concave glass which would neutralize a convex one of 5 inches focus, and which is distinguished as —5″, will enable him to see distant objects with accuracy.

In determining what arrangement of glasses should be made use of, the degree of myopia and the patient's general circumstances must be considered. If his sight for near objects be acute, and his amount of myopia not very great, the occasional use of a hand-glass or spectacles may be enough; but in no case should a single glass be employed. The habitual use of a glass to one eye, has in some cases a tendency to induce in the other a feebleness of vision, and a slight eversion of the eyeball. When the myopia is so considerable that type cannot be discerned unless held within 2 or 3 inches of the cornea, spectacles ought constantly to be worn.

[To increase the distinctness of the type by enlarging the retinal image, the patient is likely to hold the page nearer to his eye than the actual far point and to indicate a higher degree of myopia than really exists; it is better, therefore, to test the degree of myopia by finding the glass that gives the best vision at twenty feet. Even for distance, young persons often increase the apparent myopia by unconsciously using their accommodation when looking through concave glasses, and myopia may be simulated in this way when the refraction is emmetropic or hypermetropic. As great harm may be done by the use of concave glasses of too high a power, it is safer to use atropia before testing. The treatment of myopia demands great care and judgment, particularly during childhood, when the tendency to increase is greatest. The statistics of Cohn, of Breslau, based on the examination of more than ten hundred school children, and supported by similar researches of many other observers in Europe and this country, show a startling percentage of increase of myopia during school life; the result, in many instances, of the neglect of proper conditions as to light, type, hours of work, construction of desks, and hygienic surroundings. The anatomical cause of the defect is an elongation of the antero-posterior axis of the eye, and its increase is due to a further extension of this axis by a stretching of the posterior portion of the sclerotic, and a bulging backward of the ball. Any cause that produces intra-ocular congestion, and, therefore, increased intra-ocular pressure, must promote this extension. Among these causes are, excessive convergence and strain of the accommodation, and such glasses must be ordered as will relieve the former without inducing the latter.

In cases of myopia of less than about $\frac{1}{6}$, the patient will usually wear glasses for distance, and read without them, and, as a rule, there is no objection to this, provided the power of the glass is not greater than the degree of myopia. In very high degrees of myopia (as $\frac{1}{2}$ or $\frac{1}{3}$),

particularly if, as is generally the case, there is considerable amblyopia from stretching of the choroid and retina, and other intra-ocular changes, it is frequently best to give up all attempt at convergence and binocular vision, and to read with the print held close to one eye, allowing the other to diverge. In the intermediate degrees of myopia, if, with full correction, vision is perfect and accommodation strong and easy, the glasses that neutralize the whole of the myopia can be worn constantly. If there is diminution of vision (amblyopia), and irritability of the eyes, particularly if the ophthalmoscope shows a large crescent, and thinning of the choroid, glasses should be selected for near work which place the far point at from 12″ to 24″, while a stronger pair may be used for distance. If weakness ("insufficiency") of the internal recti muscles renders convergence difficult, and there is a tendency of one eye to diverge, the necessity for convergence is sometimes diminished by the use of prisms, with their bases towards the nose; or it may be necessary to restore the muscular balance by section of the external rectus of the deviating eye.

The necessity for glasses for reading in myopia arises from the excessive demand upon convergence, and the consequent disturbance of the relation between convergence and accommodation. In emmetropia, when the type is held at ten inches from the eyes, there is an accommodative effort of $\frac{1}{10}$, and a corresponding convergence of the optic axes to ten inches, a natural and easy associated action of two sets of muscles (the ciliary and the internal recti), both supplied by branches from the third pair of nerves. In the case of myopia of $\frac{1}{10}$, on the contrary, the same degree of convergence is demanded, while the accommodation is entirely suppressed. Hence arise asthenopia (weak sight), general irritability of the eyes, conjunctival congestion, and often headache and other nervous symptoms. Concave glasses give relief by removing the far point, and thus creating a demand for accommodation in near vision.

It should never be forgotten that a highly myopic eye is usually a diseased eye, and requires judicious use, as well as careful treatment. Not only has the thinned and distended sclerotic a tendency to increase the myopia by giving way still more, but the choroid, in the attempt to follow it, is dangerously stretched, and becomes liable to inflammation and atrophy. Hence the terms "progressive myopia" and "sclerotico-choroiditis posterior." The results of this morbid process are too often seen in large patches of choroidal and retinal atrophy, or, more fatal still, to visions detachment of the retina from effusion of serum between it and the choroid.

Apparent myopia is sometimes produced in emmetropic, or even in hypermetropic, eyes by a spasmodic action of the muscle of accommodation, which adapts the eye to a near point, even when it is directed to a distant object. This may be the result of excessive or imprudent use of the eyes, but is most frequently met with only in connection with general nervous irritability. It is easily detected by the use of atropia, which, by paralyzing the accommodation, restores the eye to its emmetropic or hypermetropic condition. It is sometimes necessary to continue the use of atropia for weeks, or even months, to permanently relax the spasm.

The opposite condition of paralysis of the ciliary muscle is sometimes met with. Except in case of myopia, it renders reading impossible, though distant vision may not be materially affected. It occurs not infrequently as one of the sequelæ of diphtheria. A partial paralysis, or, at least, a decided weakening, of the accommodation, is the rule after childbirth.]

In speaking of hypermetropia, I said (p. 30) that, in consequence of a short antero-posterior diameter of the globe, neither parallel nor divergent rays could be brought to an exact focus on the retina. Now these are the only rays that are met with under natural conditions; or rather, as I have already observed, all luminous rays, strictly speaking, fall upon the surface of the eye with a greater or less amount of divergence. Convergence of rays is always an artificial result, caused by their transmission through a convex lens.

The unassisted hypermetropic eye, therefore, sees neither near nor distant objects distinctly [without accommodative strain] but the difficulty of seeing near and small things is so much more obvious to the patient than his inability to define distant ones, that he commonly seeks medical advice on account of difficulty in reading. To make the retinal image larger, he often brings the type near to the eye, and hence believes himself to be "short-sighted." But even when held near, he can only read it for a very short time, with a constant painful effort, and a sense of straining and fatigue; and when the defect exists in a very high degree, reading is altogether impossible.

[This "accommodative asthenopia" is not always the only result of hypermetropia, which, in persons of sensitive nervous organization, often gives rise to more general disturbance. In fact, the symptoms referred to the eyes may be the least prominent, or the sufferer may

not even suspect his eyes at all, while the strain is manifesting itself by headache, dizziness, nausea or nervous irritability, to such an extent as to excite apprehensions of serious disease of the brain.]

The only remedy for hypermetropia is the use of convex glasses. The cause of the defect was formerly very imperfectly understood, although its results were familiar to every ophthalmic surgeon, and constituted one of the most troublesome and unsatisfactory portions of his practice. Under the vague title "Impaired Vision," cases of hypermetropia were treated with an endless variety of external and internal medicines, all equally fruitless.

The focal length of the lens necessary for giving such convergence to parallel and divergent rays as may suffice to bring them to a focus on the retina affords a designation for the degree of hypermetropia. Thus if a glass of 10 inches focus produces upon the retina an exactly defined image of the test-type, while distant objects are clearly seen with a glass of 30 inches, the patient is said to be hypermetropic $\frac{1}{10}$ and $\frac{1}{30}$.

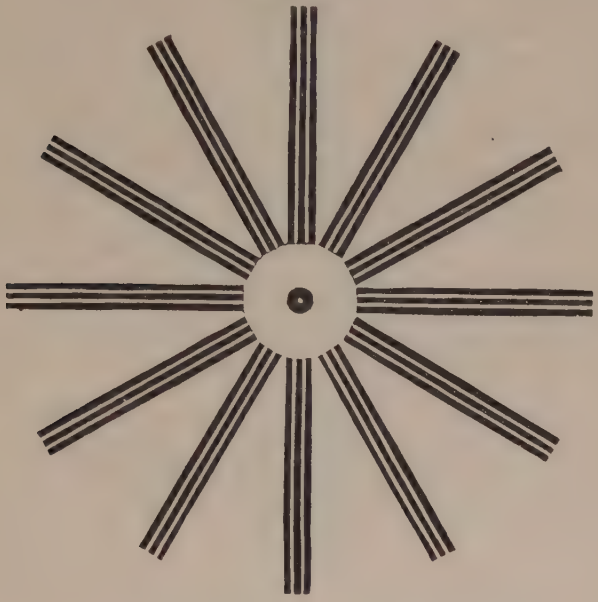
[The degree of total hypermetropia is a constant quantity, and is measured by the strongest convex glass through which the patient, under atropia, has the best vision for distance. Whether or not he will require a stronger glass for reading is entirely a question of accommodative power. Patients with a low degree of hypermetropia and strong accommodative power often get on comfortably with glasses for near work only; but, as a rule, it is better for hypermetropes to wear glasses constantly. This is absolutely necessary if there is a tendency to strabismus. On account of the unnatural relation established between accommodation and convergence, it is not always possible for a person with a high degree of hypermetropia to wear the glasses that correct the whole of it, though this result can usually be reached by gradually increasing the power of the glasses; otherwise, the strongest glass that can be worn with comfort should be prescribed. An hypermetrope, who is also presbyopic, will require stronger glasses for reading than for constant use. Except in the case of patients beyond middle age, the accommodation should be paralyzed by the use of a mydriatic before concluding the test. If this causes a decided diminution in distant vision, the existence of hypermetropia or astigmatism is established. A drop or two of a solution of atropiæ sulph. (gr. viii to f℥j) applied twice with an interval of half an hour, will usually completely suspend the accommodation in an hour after the first application. In exceptional cases it may be necessary to make an application (gr. iv to f℥j) three times a day for several days. The effect does not pass off entirely for about ten days. To avoid this inconvenience, the hydrobromate of homatropia, a derivative of atropia, the effect of which is much more transient, is recently coming into use by ophthalmic surgeons. It is more likely to irritate than atropia, and is, as yet, very expensive. The sulphate of duboisia, which is preferred by some to atropia, has also the disadvantage of much greater cost.]

As hypermetropia depends upon an original malformation of the eyeball, children affected with it must be provided with suitable spectacles, or they will be unable to read sufficiently for the common purposes of education. Donders insists on the necessity for spectacles being constantly worn by hypermetropic patients, so as to prevent over-exertion of the effort of accommodation; but we can hardly expect a school-boy to play in spectacles, however willingly he may resign himself to them as indispensable for study, and we must in most cases content ourselves with insisting on their being always used for reading, writing, drawing, etc. Adults who, although hypermetropic, have committed themselves to unsuitable occupations, involving continuous application to near objects—clerks, compositors, tailors, needlewomen—will usually be willing enough to wear spectacles at all times. In some cases one pair of glasses will suffice, in others more convex lenses will be needed for near objects, and less convex ones for distance.

[In astigmatism, each principal meridian must be tested separately, and the astigmatism corrected by a cylindrical glass. The axis of such a glass, which is a segment of a cylinder instead of a sphere, has no curve, but is simply plain glass, while any desired curve may be given to the opposite meridian. Rays of light, therefore, passing in the plane of the axis are not refracted, and the axis is made to correspond to the emmetropic meridian of the eye. In simple astigmatism a cylindrical curve only will be required; while in compound or mixed astigmatism, the least ametropic meridian is corrected by a spherical curve on one side of the glass, and a cylindrical curve, corresponding to the difference between the meridians, is ground on the other side. The existence of astigmatism and the direction of the principal meridians may be determined by means of Dr. Green's test card, represented in reduced size in Fig. 255. The radiating lines are made of such a size as to be seen distinctly by the normal eye at 20 feet. If the eye is emmetropic, they will all appear equally distinct. In simple astigmatism, one set

will appear sharply defined, and that at right angles to it will seem most blurred. If compound or mixed astigmatism exist, the spherical glass must be found that will make one set distinct. The principal meridians having been determined, they must be tested separately. The stenopæic slit (a slit about two millimetres wide in an opaque disc) is placed before the eye in a direction corresponding to one of these meridians, and the glass found which, placed in front of it, gives

Fig. 249.



the best vision for the test letters at 20 feet. The slit is then turned in the direction of the opposite meridian, which is tested in the same way. In simple astigmatism, one meridian, being emmetropic, is not improved by any glass, and the glass required for the opposite meridian is the measure of the astigmatism. In compound astigmatism, the difference between the glasses required is the measure of the astigmatism. In mixed astigmatism, one meridian requiring a convex glass and the other a concave, the astigmatism is equal to the sum of the fractions representing the glasses required for each meridian.

Simple myopic astigmatism. — As. M. Suppose that the principal meridians are shown by the test lines to be 90° and 180°; that when the slit is placed at 90°, a $-\frac{1}{16}$ glass gives the best vision, but that when it is placed at 180°, no glass improves vision. We have an astigmatism of $-\frac{1}{16}$ in the vertical meridian, which is to be corrected by a $-\frac{1}{16}$ cylinder ax. 180°.

Simple hypermetropic astigmatism, As. H., may be illustrated by substituting + for — in the above fractions.

Compound myopic astigmatism.—As. M. + M. Suppose that the principal meridians are 30° and 120°; that when the slit is placed before the eye at 30° a $-\frac{1}{24}$ gives the best vision, while for 120° the best glass is $-\frac{1}{12}$. We have a myopia of $-\frac{1}{24}$ with an astigmatism of $-\frac{1}{24}$, and the proper correction will be $-\frac{1}{24} \supset -\frac{1}{24}$ cyl. ax. 30°.

Compound hypermetropic astigmatism.— As. H.+H. Same as the above with + substituted for —.

Mixed astigmatism.—As. M. H. or As. H. M. Suppose that the principal meridians are found to be 60° and 150°, and the refraction of the former + 18, and of the latter $-\frac{1}{36}$. The difference between these two meridians is $\frac{1}{12}$, and the ametropia will be corrected by $-\frac{1}{36} \supset \frac{1}{12}$ cyl. ax. 150°.

The above methods of determining the principal meridians and testing the refraction of each are given merely by way of illustration. Of course, they may be varied almost indefinitely, according to the fancy or the facilities of the surgeon, or the peculiarities of the case. The simple instrument of Dr. Thomson will often be found useful in testing the refraction in this as well as in other forms of ametropia. It is based on the fact shown by the experiment of Scheiner, that in looking at a point of light through two small apertures, close together, the light will appear

single if the eye is accurately focused, but double if it is not. It is easily made by piercing two pin holes two or three millimetres apart, in a common visiting card. If a candle flame fifteen or twenty feet away be observed through these holes, it will appear double if the eye is ametropic, and the glass which, placed in front of the card, brings the two images together, represents the refraction of the meridian of the eye corresponding to the line of the holes. If a piece of red glass is placed over one of the holes, one image of the flame will appear red; and the red flame will appear on the same side with the glass if the eye is myopic, but on the opposite side if it is hypermetropic. If a metallic disc the size of the trial glasses be used, it can be placed in the trial frame and the line of the holes be readily made to correspond to any desired meridian of the cornea. Dr. Thomson has given formulæ for determining the refraction even without the use of glasses.—(Am. Journ. Med. Sci., Jan. and Oct., 1870.)

Metric system in the numeration of glasses.—In what is now called the "old system," glasses are designated by numbers which indicate, in inches, the focal distance of the lens. As the power of a lens is in inverse proportion to its focal distance, the value of a glass is expressed by 1 divided by the focal distance. Thus, a lens of six inches focal distance is $\frac{1}{6}$, and one of twelve inches focal distance, having only half the refracting power, is $\frac{1}{12}$. The unit, therefore, is a glass of one inch focal distance, or $\frac{1}{1}$. While there is at least a theoretical advantage in this, this method is subject to two decided disadvantages. 1st. A lens of one inch focal distance is too large a unit; such a glass is never used in practice, and all others must be expressed in fractions, which are troublesome to calculate. 2d. The inch is a variable quantity, having a different value in different countries. To remedy these difficulties, a new system is being generally adopted, based on the following principles:—

I. "The substitution of the metre for the foot as a basis for numbering glasses.

II. "Numbering glasses according to their refracting power, and not by their focal distance.

III. "The choice of a unit sufficiently feeble, so that the numbers of lenses generally in use may be expressed in whole numbers and not in fractions, the intervals being as far as possible the same between the different numbers."

The unit selected is a lens with a focal distance of one metre, which is called a "dioptric" (D). Number one of the series is 1D. Number two, having twice the refracting power of number one, is 2D; 3D has a refracting power of three dioptrics, etc. As weaker glasses than 1D are required, fractions of a dioptric are used for these, and are expressed in decimals. Thus, 0.5D has half and 0.25 D one-quarter the refracting power of one dioptric. The intervals between the lower numbers having been found too great, have also been divided in the same way; as 1.25D and 2.5D.

A metre is equal to thirty-seven French inches, and the French inch is generally used in the trial sets of the old system. To translate any number, therefore, from one system to the other, it is only necessary to remember that a dioptric is equal to a $\frac{1}{37}$ glass. A 2D glass is nearly the same as an $\frac{1}{18}$, 3D as $\frac{1}{12}$, etc. To reduce a dioptric glass to an expression in inches, divide its number by twenty-seven; to reduce one of the old system to dioptrics, multiply its number by thirty-seven.

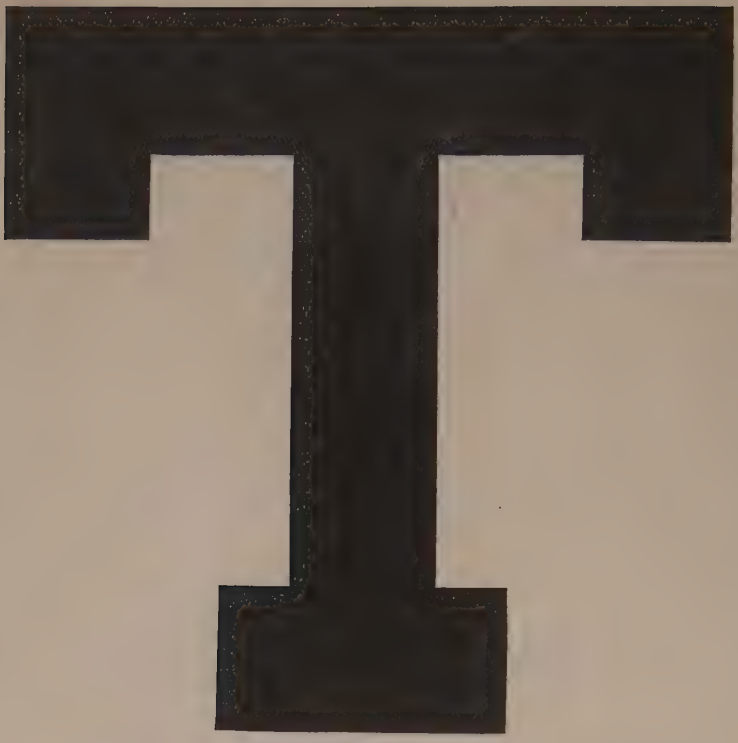
Expressed in English inches, a dioptric would be a $\frac{1}{39\frac{3}{8}}$ glass, and the Prussian inch is nearly the same as the English.]

Test-types.—It is evident that in examining a patient's sight some definite tests must be selected, and printing-types are the best and most convenient objects. As freer intercourse was established between different countries, it became more and more desirable that some uniform standard of reading-tests should be agreed upon, so as to enable ophthalmic surgeons to understand the reports of each other's cases. The sizes of printing types, however, are not everywhere the same, and persons are usually unacquainted even with the typographical terms of their own country—*pearl*, *minion*, *brevier*, *bourgeois*, *pica*, *etc.*—unless they happen to have had some practical experience as authors. When, therefore, E. Jæger published in 1854 a series of printed tests, the letters of which were distinguished by numbers instead of by technical names, they were generally accepted by the profession, and referred to in reporting cases. More recently Snellen has devised a special form of type, in which the letters are all drawn on a regularly proportioned scale of thickness of stroke.[1] In doing this, he has acted on the following principle. If the eye be taken as a centre, and from it a circle be described of 12 inches in diameter, a well-illuminated object occupying only $\frac{1}{60}$ of a degree in this circle can be

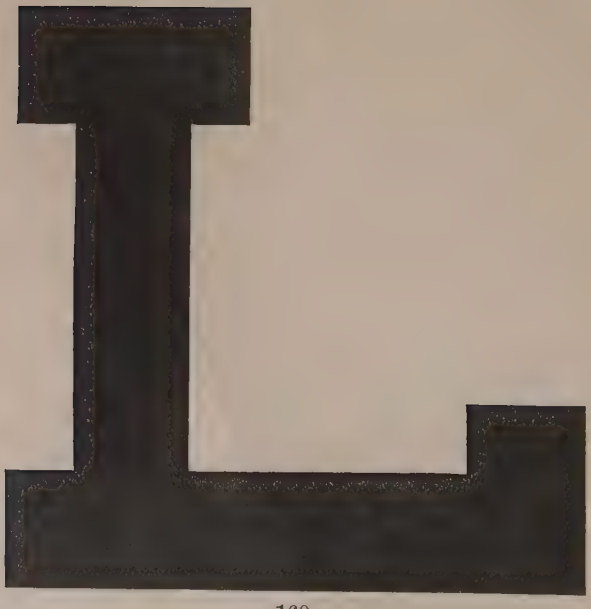
[1] It is only with letters of a certain size, however, that Snellen has carried this plan into effect. The larger letters are all drawn on the principle he lays down, but his letters No. 1, No. 2, and No. 3, are all printed from ordinary thick and thin metallic types. (Test-types for the Determination of the Acuteness of Vision, 3d edit., 1866.)

TEST LETTERS.

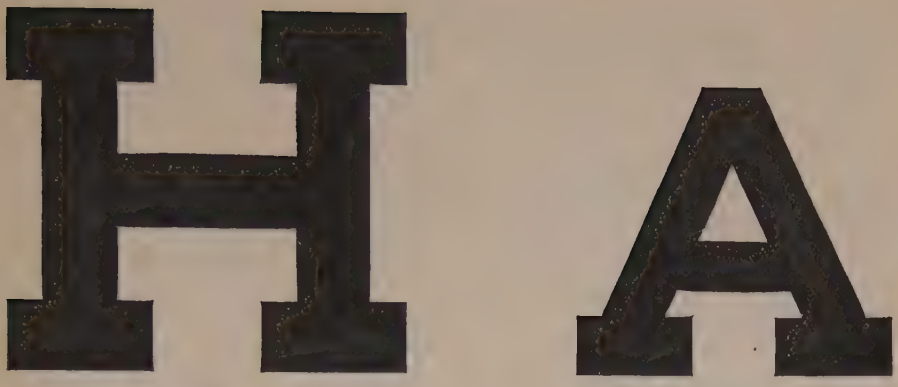
DRAWN ON THE SCALE OF DR. H. SNELLEN'S TEST TYPES.



200

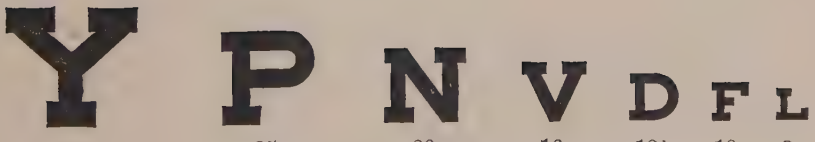


160



100 80

64 50 40



32 25 20 16 12½ 10 8

recognized. In other words, certain objects, the size of which is about $\frac{1}{300}$ of an inch, can be seen by an emmetropic eye at a distance of 6 inches. Such objects, however, as printing-types cannot be distinctly perceived at a smaller visual angle than about five minutes of a degree. Snellen's letters, therefore, are uniformly drawn in lines, the thickness of which is equal to one fifth of the whole letter, so that while a letter occupies five minutes of the field of vision, each line composing the letter would occupy a space of only one minute. Each size of Snellen's type is distinguished by a figure, indicating the number of feet at which the letters ought to be legible to an emmetropic eye. In a second edition of his test-types (1864) Snellen printed some tables of "test-dots," which may be used by persons who cannot read. These dots had been contrived by the British army authorities for determining the acuteness of vision in recruits.

No doubt the principles on which Snellen's letters are formed are more scientific than those which regulate Jæger's, and are to be preferred in cases where optical experiments are made on intelligent and educated persons. But those of limited reading powers, especially in hospital practice, are often puzzled by the unusual forms used by Snellen, and cannot read them fluently, even when quite able to read the ordinary type they are accustomed to in books and newspapers.

[Snellen's types are always used for accurate determination of the acuteness of vision.]

CHAPTER II.

EXAMINATION OF THE EYE.

Superficial Examination.

The conjunctiva and cornea.—For examining the former of these structures, when attacked with the slighter forms of ophthalmia, no special manipulations are required. The ocular portion is open to the surgeon's observation, and, to explore the lining of the lower lid, it is only necessary to depress the tarsus with the point of the finger. It is often difficult, however, to obtain a satisfactory view of the cornea in a child suffering from that irritable form of inflammation commonly known as *Scrofulous Ophthalmia*, but more correctly called *Keratitis*. The surgeon does but waste his time who attempts to coax or parley with such a patient. Light causes so much pain, that the child makes every effort to exclude it, by keeping the eyelids firmly pressed together, and even, in severe cases, thrusting his face against the pillow, or the dress of the attendant.

The surgeon should sit, and spread a folded towel across his knees. Opposite to him sits the attendant, who secures the child's hands, and lowers him backwards until his head is received between the surgeon's knees, and there firmly held. Thoroughly to expose the cornea without everting the lids requires tact, which practice alone can give. The extreme tip of the fore-finger, with a bit of rag twisted over it to prevent slipping, having been laid upon the middle of the upper tarsus, at the very edge—between the roots of the eyelashes and the globe—the lid, without any dragging of the skin, is to be steadily pushed in a direction which, in the erect position of the body, would be upwards and backwards. In this way the greater part of the cornea is at once exposed; but if the finger is allowed to drag the skin of the lid, the tarsal cartilage instantly becomes tilted over, and the swollen conjunctiva, bulging forwards, hides the eyeball from view. By a similar manœuvre the lower lid may be depressed; but this is not necessary in examining the cornea, for that part is always rolled upward to seek the shelter of the upper lid.

If a more prolonged examination of the eyeball be required, as in a case of *Ophthalmia neonatorum*, a spring speculum must be employed, adapted, as regards width and strength of spring, to the small size of the palpebral fissure [or the upper lid may be held open with an elevator.]

To expose the conjunctiva of the upper lid, the part must be everted, as if the surgeon were in search of a foreign body; and, indeed, it is with such an object that the eversion is most frequently performed. Whenever a patient complains of having had a fragment of anything blown into the eye, and a careful scrutiny of the edges of the tarsi, the fold of the lower lid, and the surface of the globe, has failed to reveal the cause of irritation, the upper lid should be treated in the following manner:—A pen, the extreme feather end of which is cut off, so as to leave a stem just thick enough to resist bending, is laid across the upper lid, about half an inch from its free margin; then, while the finger and thumb of the other hand grasp the eyelashes growing from the middle of the lid, the pen is pressed a little downwards, at the same moment that the lid is drawn first a little forwards, and then upwards; the tarsus will suddenly tilt and fold over, so as to expose its conjunctival surface.

This manœuvre, simple as from description it seems to be, requires a good deal of *knack*. Both hands must act together,

and if at the moment the turn is being given to the lid, the patient is told to look downwards, the eversion is much more readily accomplished. Minute foreign bodies, which have fixed themselves beneath the upper lid, are almost invariably found very near its tarsal margin; they should be lightly picked off with the feather or nib of the pen used for effecting the eversion. [They will generally adhere readily to a dry handkerchief on the end of the finger or the point of a pencil, and are more easily removed in that way.] A pen is not only more convenient than a probe, but it has the advantage of appearing less formidable to a timid patient.

Lens and iris.—Great care is required in examining a patient in whom we have reason to suspect that cataract is commencing. The first faint streaks of opacity in a lens will often escape detection, unless light be concentrated on the part by means of a convex glass of about an inch focus. I need hardly say that in all daylight examinations of the eye, the direct rays of the sun are to be avoided. The observer must also take care that light does not fall upon the cornea from more than one window; and that reflections from mirrors and other polished surfaces do not interfere with the single ray [cone] of direct light which should fall on the part to be examined. No lens can be fully seen until the pupil has been widely dilated with atropine; but inasmuch as this dilatation alters the visual condition of the eye, all particulars as to the patient's range and distinctness of sight should be noted before the atropine is applied.

In the very earliest stages of cataract, examination by daylight, even when the light is concentrated by a convex glass, may sometimes fail to detect alteration in the lens. Neither can this be made out with the ophthalmoscope. But if in a darkened room the rays of a flame be thrown sideways upon the lens, by means of a convex glass, and the part be then carefully scrutinized with the naked eye, highly refractive dots, like minute oil-globules—which probably they really are—will be found scattered throughout the substance of the lens, the fibres of which also are now made visible as delicate radiating lines.

The contractility of the iris is tested by placing the hand close to the eye for a second or two, and then quickly withdrawing it, so as to allow the light to fall suddenly upon the pupil, the other eye meantime being closed. The sympathy between the two eyes should next be examined, by observing how far light admitted to one eye influences the iris of the other.

This separate examination of each eye is a very important point, for cases occur in which, while one eye is sound, the other is so utterly blind as to have lost all perception of light, yet the pupil of this blind eye will contract as soon as light is admitted to the sound one. An extensive adhesion between the edge of the pupil and the capsule of the lens (*Synechia posterior*) would at once attract notice; but if any slight deviation from the healthy round form of the pupil exists, its margin must be carefully examined, to see if any very small adhesion be the cause of such irregularity. A very slight synechia often affords a valuable hint towards diagnosis, as proving that iritis must at some period or other have attacked the eye. Whenever the surgeon is in doubt as to the existence of adhesions, the application of atropine will determine the question.

It should ever be borne in mind that a dilated and inactive pupil by no means necessarily implies that the retina is diseased; nor an active pupil that the retina is sound. If one pupil be large and immovable, and the sight of that eye dim, the patient should be made to look at type through a large pin-hole in a card held close to the cornea. The object of this will be explained under the head "Mydriasis."

We must never be satisfied with a patient's vaguely telling us that he can or cannot read; we must have a precise and definite standard, such as is afforded by his reading to us aloud from type of several sizes. In hospital practice, those who have not learned their letters—who, as they express it, are "no scholars"—may be told to count small dots, point out a single and a double line, or select an asterisk from other typographical marks. This subject has been more fully treated under the head of "Optical Defects."

The simple modes of examination hitherto mentioned have at all times been at the surgeon's command; I come now to consider the use of an apparatus—the *Ophthalmoscope*—the invention of which has enabled us to explore those deeply-seated structures previously altogether beyond the range of observation.[1]

[The first thing to be decided in the examination of an eye is whether or not it

[1] In the first edition of the present Essay there was no special section on the Examination of the Eye. In now adding a preliminary chapter on the subject, I have here and there made use of a paragraph from my little volume on Eye Diseases. When I have had to repeat former statements, I have not thought it necessary to vary the wording merely for the sake of giving an air of novelty to some commonplace directions.

has full acuteness of vision. By acuteness of vision is meant the ability to distinguish the form of objects, and Snellen's test-types furnish a ready means of determining it. They are constructed of such dimensions as to be readily distinguished, by the normal eye, at the distance, in feet or metres, marked above them. Thus, No. 15 should be read at 15 feet, No. 20 at 20 feet, No. 40 at 40 feet, etc.; and the acuteness of vision is expressed by the distance at which the letters are seen divided by the distance at which they ought to be seen. If at 20 feet No. 20 is read, $v=\frac{20}{20}=1$, or normal; if only No. 40 can be made out, $v=\frac{20}{40}=\frac{1}{2}$; if only No. 60, $v=\frac{20}{60}=\frac{1}{3}$, etc. If there is diminution of vision, it is important to decide whether it is due to want of transparency of the media, loss of sensitiveness of the retina, or disease of the nerve or brain, or simply to defective refraction. This may generally be determined by the simple expedient of directing the patient to look through a small aperture, as a pin hole in a card. A decided improvement in vision is proof of defective refraction; if the vision becomes normal, the difficulty must be entirely optical. The improvement is most marked in cases of astigmatism, and is due to the fact that the small opening admits only the central rays of the cone of light coming from the object, and cuts off the peripheral rays which make most confusion in the retinal image when the dioptric system is not properly focused. If, when the hole is moved from side to side in front of the eye, objects appear to move in the same direction, the defect is myopic; if in the opposite direction, it is hypermetropic. A candle flame is the best object for this test. A Loring or Knapp ophthalmoscope furnishes a ready means of approximating to the degree of myopia or hypermetropia; while the patient looks through the opening in the mirror, held close to his eye, the disc is turned until the glass is found which gives the best vision.

The *accommodation* is determined by measuring the distance of the nearest point at which Snellen's smallest type can be read fluently. If it cannot be read at all, a convex glass may be used, and its power deducted from the result. If it is read at 6 inches, $A=\frac{1}{6}$. If a $+\frac{1}{12}$ glass is used and the type can be read at 8 inches, $A=\frac{1}{8}-\frac{1}{12}=\frac{1}{24}$. If ametropia exist it must be corrected before the accommodation is measured.

For examining the *field of vision* a number of instruments have been invented, most of them modifications of Förster's perimeter; but for ordinary purposes a blackboard is sufficient. The patient is directed to close one eye and fix the other on a small dot or cross in the centre of the board, placed immediately in front of the eye and ten or twelve inches from it. A small piece of chalk at the end of a black handle is then approached to the fixation spot from different directions, and the points noted at which it is first seen in each. A line drawn through these points marks out the field of vision. Care must be taken that the patient does not move his eye. When vision is absent in a localized spot, which may be central or more or less peripheral, such spot is called a *scotoma*. It must be remembered that a natural scotoma exists at the point in the field corresponding to the optic nerve entrance. The field of color vision may be taken in the same way by substituting a small piece of colored paper, about a centimetre square, for the chalk.

To determine if *insufficiency of the internal recti* exist, vertical diplopia is produced by means of a prism placed before one eye with its axis vertical (base either up or down) and directing the patient to look, with both eyes, at a candle flame 15 or 20 feet distant. If there is a proper balance of the power of the recti muscles, the two images of the flame will be in the same perpendicular line, but if there is weakness of the interni, the images will have a diagonal direction; they will be separated laterally as well as vertically. The strength of the prism which, with its base towards the nose, brings the two images to the same vertical line, is the measure of the insufficiency. For near vision, a small dot or cross on a piece of paper or card is used instead of the flame. Double vision is produced when the image of an object falls on the macula in one eye, and away from the macula in the other. If one eye diverges, the image falls to the outside of the macula; a prism, which deflects the rays of light passing through it towards its base, can be made to remove the image to the unnatural position of the macula, or, if there is also vertical diplopia, to a position immediately above it or below it. The object of producing vertical diplopia is to prevent the effort at binocular vision, which masks the insufficiency by exciting the action of the internal recti. If a high degree of insufficiency exists, one eye will diverge if it is excluded from vision by placing the hand in front of it while the patient looks at a near object.

The *intra-ocular tension*, or degree of firmness of the eyeball, is determined as follows: Direct the patient to close the eye gently and look well downwards, and then note the resistance offered to the finger placed on the top of the ball, as near the equator as possible, and pressing it against the floor of the orbit. Some surgeons use two fingers, just as in feeling for fluctuation in a swelling. There is no

definite and accurate measure of the degree of tension; it is merely estimated as greater or less than the normal. Normal tension is recorded by Tn; a slight increase, by +T1; a greater increase, by +T2; and a stony hardness, by +T3. A just perceptible softening is —T1; a more decided degree is —T2; and an almost complete loss of resistance is —T3. +T? means doubtful, but perhaps a little hard; and —T?, the opposite condition.

The anterior part of the vitreous humor, the lens, iris, anterior chamber, and cornea, are best examined by *oblique illumination*. Two lenses of two or three inches focal distance are required, and the object glasses of the ophthalmoscope answer the purpose well. One lens is used to concentrate a cone of light from an Argand burner obliquely upon the point to be examined, while the other is held in front of the eye as a magnifier. Opacities in the lens or cornea, minute foreign bodies, morbid growths, delicate exudations, pupillary adhesions, etc., can readily be detected in this way.]

Ophthalmoscopic Examination.

It is little more than thirty years since Cumming[1] first demonstrated that, by a certain arrangement of light, the fundus of the healthy human eye could be made visible, so far at least as to allow of its color being seen. Although he never obtained a view of the optic nerve or vessels of the retina, his investigations prepared the way for the discovery of the ophthalmoscope, by proving that the fundus of the living eye was not really a dark-colored surface; but that under certain conditions it reflected the rays of light falling upon it, so as to present a brilliant surface to the eye of the observer. An indistinct reddish gleam from the retina, or a white reflection from the optic nerve, had been sometimes accidentally seen by those engaged in the study of eye-diseases; but they had regarded these glimpses of the fundus of the eye as exceptional, and as indicating something morbid in the deep tissues. Thus, in certain cases of impaired sight, with dilatation of the pupil, Beer had observed a peculiar luminous appearance, which he assumed to be the result of some morbid change in the retina; and he accordingly made use of the term "cat's-eye amaurosis" to designate the disease which he supposed to give rise to this luminous appearance. Other observers had attributed it to a deficiency of pigment, still assuming that, in a state of health, the fundus of the eye must necessarily appear black.

[1] Medico-Chirurgical Transactions, 1846.

The first ophthalmoscope was invented by Helmholtz, and described by him in a tract published in 1851.[1] He began by showing in how simple a manner, by using a slip of glass, the surface of the retina might be made visible; and then constructed an apparatus of several superimposed glass plates, with which he obtained a more perfect view of it. These first examinations were made without any artificial dilatation of the pupil, so that only a limited extent of the retina could be seen. He was able, however, to distinguish the optic nerve, and the vessels emerging from it.

In 1852 Ruete[2] invented an ophthalmoscope on a different principle from that of Helmholtz, light being thrown into the patient's eye by means of a concave mirror, through a hole in the centre of which the observer looked directly upon the illuminated retina. The practical objection to Ruete's instrument consisted in its being fixed to a stand, and therefore ill adapted to observe an organ so frequently in motion as the eye. Coccius[3] avoided this inconvenience by constructing a small perforated mirror, to be held in the hand; and this instrument was still further modified by Anagnostakis,[4] whose ophthalmoscope, from its extreme simplicity, appears to me one of the most useful that has yet been invented, and quite the best for the student to begin with. It consists of a circular glass mirror about an inch and three-quarters in diameter, slightly concave, and perforated in the centre with a round hole, the tenth of an inch wide. The mirror is set in a metal frame, to which a handle is fixed. Liebreich's instrument is made, not of glass but of polished metal, with a focus of from four to six inches. One of the advantages of the metallic mirror is that the edge of the aperture can be made quite thin, whereas the glass mirror must be backed by a plate of metal, and by drilling through this, and through the thickness of the glass, the aperture really becomes a short tube. Any reflection from the wall of this tubular aperture must be prevented, by carefully covering it with a dead black coating. At the back of Liebreich's instrument there is a little hinged clip for holding a concave or convex glass against the sight-hole. The concave glass is nec-

[1] Beschreibung eines Augenspiegels zur Untersuchung der Netzhaut im lebenden Auge, Berlin.

[2] Der Augenspiegel und das Optometer, Göttingen.

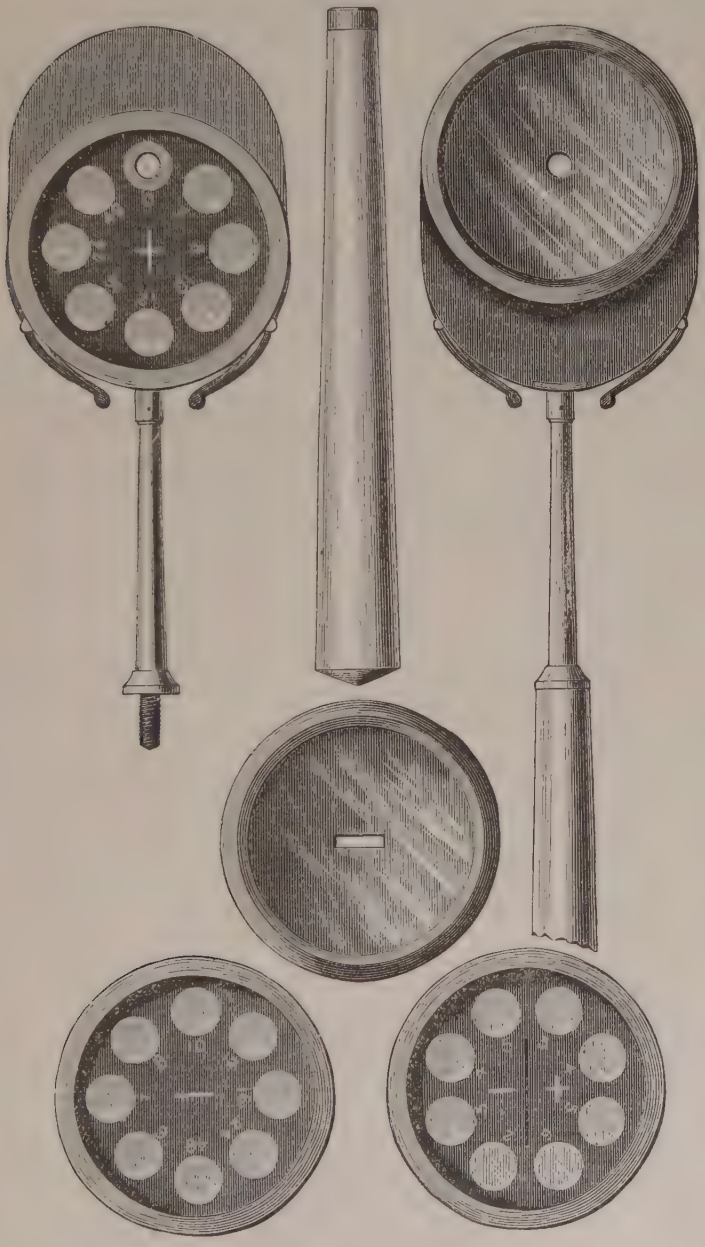
[3] Ueber die Anwendung des Augenspiegels, Leipzig, 1853.

[4] Essai sur l'Exploration de la Rétine et des Milieux de l'Œil sur le Vivant, Paris, 1854.

essary in making an examination by the "direct" method, if the patient or observer be myopic.

There are various forms of the ophthalmoscope which, in the hands of practised observers, will afford a good view of the fundus of the eye, but it is well for the student to begin with the simplest kind; those, for instance, which I have just mentioned. When habit has given dex-

[Fig. 250.]



terity in combined management of the mirror and object-lens, the *binocular* ophthalmoscope, as invented by Giraud-Teulon, or some improved form of it, may be employed.

The instrument now almost univer-

sally used in this country is some form of that known as Loring's (Fig. 250) or Knapp's. It differs from the older instruments chiefly in having a number of small lenses, convex and concave, so placed in a revolving disc behind the mirror that they can be brought in rapid succession before the eye of the observer. This not only enables the observer, in the direct method of examination, to adapt the instrument to the refraction of his own eye and that of the patient, but to measure the degree of any defect in the latter.]

Before commencing a thorough examination of a case, it is necessary to dilate the pupil with atropine, unless it has become permanently dilated from disease. In many instances, however, a glance at the optic nerve and the parts adjacent is all that is required, and in that case it is unnecessary to subject the patient to the inconvenience of atropine.

The observer and the patient sit face to face in a room from which daylight is excluded; the only source of illumination being a lamp, or, still better, a jet of gas issuing from a jointed tube, so that the flame can be placed higher or lower, according to the height of the patient's head. The flame should be on a level with his eyes, and just far enough behind him to prevent any of the direct rays falling on his cornea. The chimney surrounding the flame must be of transparent glass, and, if faintly tinged with blue, it will modify the red rays, and impart to them a whiteness nearly resembling that of ordinary daylight. The observer places the back of the mirror close to his own eye, so that he looks through the central aperture, and holds the instrument at such an angle that the reflected light from it falls into the patient's pupil. This is always very difficult for a beginner to accomplish, but a little practice soon makes it easy. He will know that he holds the instrument in the right position and at a proper distance from the eye, by seeing the fundus assume a brilliant reddish appearance.

Still holding the ophthalmoscope in the same position, he takes in the other hand a convex glass [object glass] of two inches or two inches and a half focus, and places it a little in front of the cornea. If the fundus of the eye be properly illuminated, and the convex glass correctly placed, some of the retinal vessels will now be distinctly seen. The observer is often confused by seeing a small bright image of the mirror reflected from the surface of the object-lens. This image can be got rid of by giving to the lens a slight inclination. [A much more satisfactory view is obtained by magnifying the aërial image with a convex ten inch "eye piece" placed behind the mirror. This is always done in the indirect examination.]

By turning the eye in various directions every portion of the retina is successively brought under the view of the observer. The necessity for varying the position of the eye constitutes a great objection to the more complicated ophthalmoscopes, which are fixed to a table or other support; and some eyes are so unsteady, and so little under the patient's control, that the observer is obliged to follow their movements by slight changes in the position of the ophthalmoscope, which can only be effected when the instrument is held in the hand.

There are two methods of examining with the ophthalmoscope—the "direct," and the "indirect." In the former method, the mirror must be brought very close to the patient's eye—an inch or two from the cornea—and the image of the retina then appears to the observer in its natural *erect* position. But this very close approximation to the patient is inconvenient; the side of the patient's head intercepts some of the light which ought to fall on the mirror; and only a limited portion of the retina, thus feebly illuminated, can be brought into view at one time. The direct method, therefore, is comparatively seldom employed, and chiefly for the purpose of examining in detail small portions of the fundus, which are seen in their true position, and considerably magnified.

In the "indirect" method, the mirror is held at a distance of several inches from the patient's eye, and a convex lens of short focus, two to two and a half inches, is placed a little in front of the cornea. In this way the inconvenient and obviously undesirable relative position of the observer and observed is avoided, the retina is more brilliantly illuminated than in the "direct" method, and a good general view of the whole fundus is obtained. The image of the retina seen by the observer is an "aërial" one, which is formed at a point between the convex lens and the ophthalmoscope, appearing there in an *inverted* position. This inversion of the parts examined must always be borne in mind by the surgeon while employing the "indirect" method.

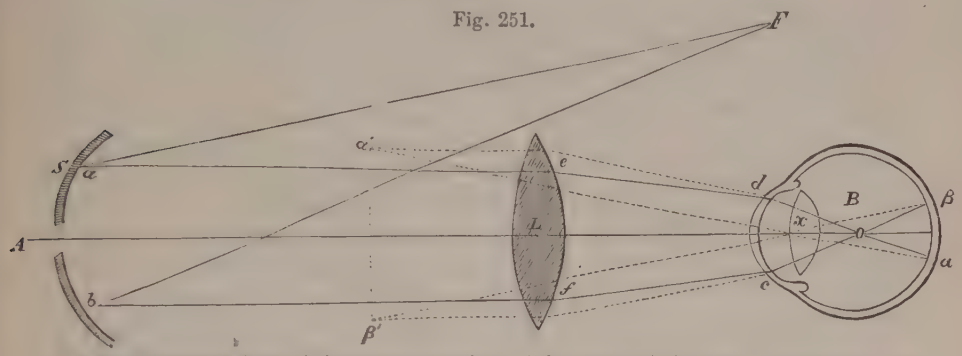
The following diagram (Fig. 251), copied from Zander's work, explains the mode in which the aërial inverted image is formed.

Within the narrow limits of the present essay, I cannot attempt to give more than a bare outline of the use of the ophthalmoscope. The literature of the subject is already overwhelming. One of the most complete treatises is that by Zander, just alluded to, Der Augenspiegel: Leipzig, 1859. It has been translated, and has undergone considerable condensation

—a process it greatly needed—by Carter, under the title of The Ophthalmoscope, its Varieties and its Use; 1864. There is also an excellent essay in French by Giraud-Teulon, contributed by him to the supplemental volume of Testelin and Warlomont's translation of Mackenzie's great work.

[For accurate examination the direct method is now universally preferred by ophthalmic surgeons; it not only gives a much more magnified view of the details,

Fig. 251.



F is the illuminating flame; *S* the concave speculum; *A* the aperture in its centre; *B* the patient's eye, before which is held a convex lens, *L*. From the flame *F* the rays *Fa Fb* fall on the speculum, and are reflected from it towards *L*. Striking the lens, *L*, at *e* and *f*, they acquire a greater convergence in passing through it, and fall upon the cornea at *d* and *c*. Traversing the patient's eye, they again converge, and, intersecting at *o*, form on the retina a "circle of dispersion," at $\alpha\ \beta$. Reflected from the retina, in the direction of the dotted lines, they pass out of the eye, and being intercepted by the lens *L*, are again refracted, and form at $\alpha'\ \beta'$ an inverted image of the retinal surface $\alpha\ \beta$, which is viewed by the observer's eye placed at *A*.

but enables the observer to determine the refraction of the patient's eye, the depth of depression in cupping of the disc, the height of prominences in the fundus, and the position of opacities in the vitreous. The somewhat greater difficulty in its use depends upon the necessity of adapting the instrument to the refraction of the eye of the observer and of the patient by means of the small lenses in the disc. This adaptation is accomplished more easily in the indirect method by a slight movement of the object glass. For satisfactory examination by the direct method, one of the more modern or "refraction ophthalmoscopes" is needed. The eye to be examined should be directed slightly outward, and the ophthalmoscopic mirror held as close to it as possible. If both the observer and the patient be emmetropic, and the former is able to completely relax his accommodation while the accommodation of the patient is paralyzed by atropia, the details of the fundus will be distinctly seen without the aid of a lens. Until some experience has been acquired it is difficult, or impossible, to relax the accommodation completely when looking at a near object, and it will be necessary to neutralize it with a concave glass. If either the patient or the observer is myopic, it will be impossible to see the fundus without a correcting glass; if both are myopic the concave glass must be used that corrects the myopia of both. An hypermetropic eye is more easily examined than a myopic or emmetropic eye, because the rays of light come from the fundus divergently, as they ordinarily come from near objects, while they pass out of an emmetropic eye parallel, and out of a myopic eye convergent. An emmetropic observer, however, if he relaxes his own accommodation completely, will require a convex glass to make the divergent rays from an hypermetropic eye parallel.

In diagnosing the refraction by the ophthalmoscope some small retinal vessel, preferably near the macula, should be selected and the glass found with which it can be seen with perfect distinctness, without the use of accommodation. For inexperienced observers, the larger vessels at the disc furnish a rougher but much easier test. In myopia the weakest concave glass, and in hypermetropia the strongest convex glass, with which the details of the fundus can be distinctly seen, represent the degree. Astigmatism is measured by focusing the retinal vessels which follow the directions of the principal meridians. As the effect of a convex glass is increased, and that of a concave glass diminished by removing them from the eye, the distance must be deducted or added as the case may be, if great accuracy is sought. Thus, a convex $+\ {}^1\!/_8$, two inches from the nodal point of the eye examined, indicates a hypermetropia of ${}^1\!/_4$, and a $-{}^1\!/_8$, a myopia of ${}^1\!/_6$. If, however, the mirror can be held nearly in the position that would be occupied by a spectacle glass, the distance may be practically disregarded. The depth of a cupping of the disc, or the height

of a "choked disc," or a tumor may be estimated by comparing its refraction with that of the surrounding fundus.]

Ophthalmoscopic Appearances of the Eye in a healthy state. (Plate X., fig. 1.)

In the heading of this section I use the word "healthy" with a certain latitude of meaning; for, apart from any serious disease, the mere advance of age imprints upon the internal tissues of the eye certain changes of appearance, which, although deviating from an ideal standard of perfect health, can hardly be termed morbid. At present, I wish to present to the reader merely a sketch of what he is to look for in an eye which fairly performs its functions as an organ of vision.

Retina.—The observer must not expect to find this tissue presenting one uniform color in all cases; the tint varies from pale red, through shades of red-orange and yellow-orange, to buff. In full-blooded persons, with a vigorous circulation, the retina would naturally have a much redder appearance than in those who are feeble and anæmic.[1] The color of the retina is almost wholly due to the vascular choroid behind it; and the amount of redness transmitted from the choroid will depend upon the quantity and condition of the hexagonal pigment between it and the retina. Some ophthalmoscopists altogether object to our speaking of the color of the retina, inasmuch as owing to its translucency, it allows the redness of the choroid to be seen. But no objection ought surely to be taken on this account to our familiarly applying the term color to the retina itself.

[It is usual to speak of the color of the "fundus" or "eyeground." It depends chiefly upon the amount of pigment in the uvea and in the stroma of the choroid, and varies with the general pigmentation of the individual. It is deep purple in the Negro and bright red in the Albino, and is much darker in the brunette than in the blonde, as is well shown in Plate X.]

Across the illuminated fundus of the eye the observer will notice large vessels radiating from a central point towards the periphery. These are the large branches of the central artery and vein of the retina; and by directing the patient to turn the eye a little towards the median plane, the observer will be able to trace these vessels to their parent trunks in the middle of the optic nerve. The vessels of the choroid, as I shall by-and-by have occasion to notice, are so entirely unlike the radiating trunks of the retina, that a single examination will suffice to prevent any subsequent confusion between them.

It requires a little more practice to distinguish between the retinal arteries and the veins. If an arterial trunk be examined where it attains its greatest size, namely, at its emergence from the optic nerve, it will be seen to be of a paler red color than the adjacent vein, and to present a double outline. The greater thickness of the arterial wall is the cause of both these peculiarities of appearance; for, of course, the color of the contained blood is less plainly seen where the wall is thicker; and while the light, reflected from behind the artery, shines through it with subdued brightness, each side of the cylinder presents a line of shadow. The coats of the veins, on the other hand, are so thin, that they allow the color of the blood to be plainly seen throughout the whole diameter of the tube. This distinction between the veins and the arteries of the retina becomes less marked as age advances. Simple inspection of a healthy eye does not detect any pulsation in the retinal vessels; but if the globe is firmly pressed with the finger, a decided pulsation may be seen, both in the arteries and veins.

[A physiological venous pulse is very common, but a pulsation of the arteries is almost a sure sign of disease.]

If the patient looks directly forwards, a very important portion of the retina comes into view, namely, that occupied by the *macula lutea*, or "yellow spot," which corresponds to the axis of vision. The retinal arteries and veins deviate a little from their regularly radiating course as they approach the yellow spot, which therefore has no large vessel in its immediate neighborhood. (Plate X., fig. 1.) Most observers, I think, must content themselves with making out the cloudy redness which indicates the position of the *macula lutea*, without actually seeing the dot which it forms. [The central dot or "fovea centralis."] Liebreich gives a drawing (Plate X., fig. 2) in which it is represented. I have, however, never succeeded in obtaining such a view of it as he depicts.

[The view represented in Liebreich's drawing, which is wonderfully true to nature, is easily seen by an experienced ophthalmoscopist.]

Optic nerve.—To bring the nerve into view, the patient must direct the eye a little towards the nose. No structure

[1] These remarks apply only to patients as commonly seen in England. Among the darker tribes of mankind, the abundance of pigment gives to the fundus of the eye, both in health and in disease, shades of color wholly different from those of the fairer races. For ophthalmoscopic appearances among the natives of India, see Macnamara's Lectures on Diseases of the Eye, 1866.

seen with the ophthalmoscope presents a greater variety of appearance than the optic nerve, even in patients who enjoy good sight. As age advances it becomes smaller, and often deviates more or less from that circular outline which one may assume as the healthy standard.[1]

Contrasted with the reddish tint of the surrounding retina, the nerve appears cream-colored, or it sometimes presents that faint tinge of pinkish gray which we are familiar with in the cineritious portion of the cerebral convolutions. The extreme edge of the disc is often of a less decided white than the central portion.

From the centre of the nerve the main trunks of the retinal artery and vein are seen emerging. Commonly each vessel issues as a single trunk, which then divides into branches, but sometimes the division into two or three trunks takes place before the vessels quit the substance of the nerve in which they are imbedded. In some cases the vessels pass off at once to their destination, in nearly straight, or slightly wavy lines, while in other cases they form several abrupt curves on the surface of the nerve before quitting it.

Choroid. — This structure exhibits a great variety of appearances under the ophthalmoscope. The distinctness with which it is seen depends upon the degree of transparency of the retina, and the condition of the hexagonal pigment-cells behind it; and it seems that considerable variations in both these tissues are compatible with good sight.

In young persons the vessels of the choroid appear dim and indistinct, as if overspread with a thin semi-opaque film; but in old persons they are sometimes so plainly seen that the observer almost forgets he is looking at them through the whole substance of the retina. It is in old persons, therefore, that the peculiar arrangement of the choroidal vessels can be best studied. They are very much larger than the radiating vessels of the retina, and are closely packed together, leaving between them narrow, elongated spaces, in which dark pigment is visible. (Plate X. fig. 2.) During the earlier periods of life these vessels present a bright red, but in old age this color often becomes mixed with a brownish tint.

[1] I have uniformly spoken of the *optic nerve*, instead of using the term "optic papilla," which some authors employ. No confusion can arise from applying the term *nerve* to that which is in reality only a part of the nerve, since no other portion than its extremity comes under our notice in using the ophthalmoscope. The term "papilla" is objectionable, too, as implying a *prominence;* and I believe the distal end of the optic nerve to be nearly, if not quite plane in a state of health. [The term "optic disc" is free from this objection.]

CHAPTER III.

DISEASES OF THE CONJUNCTIVA AND ITS AREOLAR TISSUE.

(*Ophthalmia; Conjunctivitis.*)

Inflammation of the conjunctiva, I need hardly say, accompanies many of the inflammatory processes originating in other tissues of the eyeball. In the present chapter I confine myself to those cases in which the inflammation originates in the conjunctiva, and is either limited to it, or spreads only to the sclerotic.

Inflammatory redness differs very remarkably in these two structures. It is on the inner surface of the lids, and at their point of junction with the globe, that the conjunctival vessels are largest, and their redness is most strongly marked; and the color becomes paler as the vessels diminish in size on approaching the cornea. The sclerotic vessels, on the contrary, are most visible close to the cornea, around which they form a pink circle, known as the *sclerotic zone*—a very characteristic mark of several important forms of disease in the deep-seated tissues of the eye. Even if the sclerotic be uniformly injected throughout its whole extent, this injection cannot be traced very far back from the edge of the cornea, because the redness soon becomes hidden beneath the fibrous insertions of the recti muscles. The vessels of the sclerotic are small, closely set together, and so interlaced with the proper fibres of the part that the individual trunks cannot be recognized; they merely produce the effect of a uniform tint of color, nearly resembling that of carmine. The conjunctival vessels, for the most part, are plainly seen, and, except in that high stage of inflammation termed *chemosis*, they can be observed repeatedly to anastomose, so as to form a closely-set network.

Elaborate classifications of the various forms of ophthalmia are to be found in many of the systematic works on eye-diseases; but minute distinctions, however plausible they may look on paper, are of little or no use to the practitioner. In selecting a few heads, under which to group the varieties of ophthalmia, I have been guided by the very decided peculiarities which certain forms present, or by the marked difference in the treatment

they require. Most of the slighter forms of conjunctival redness, not resulting from direct violence or the presence of foreign bodies, are due to atmospheric changes; and the cases described by authors under the name *simple ophthalmia*, are, for the most part, mild cases of catarrhal inflammation. When the sclerotic also is affected, the term *rheumatic* is sometimes added; and Mackenzie uses the words "catarrho-rheumatic" to signify that both the conjunctiva and the sclerotic are inflamed, although the inflammation may be due to the mere external agency of cold, and not to the presence of rheumatic poison in the blood of the patient.

Slight attacks of redness of the conjunctiva are commonly attended with only trifling uneasiness. The enlarged vessels, projecting above the level of the membrane, suggest to the patient the notion of foreign bodies, sand or dust, between the lids and the globe. But in other instances, where the redness is very trifling, the pain is of a neuralgic character, and it is for the irritation existing in the ophthalmic division of the fifth nerve that the patient seeks medical aid. It is important for the practitioner to remember that in such cases the suffering may be really severe, although there is far less appearance of inflammation than in other cases where pain can hardly be said to exist.

Whenever a case of ophthalmia is seen for the first time, the margins of the lids and the puncta lacrymalia should be carefully explored, as a few irregular eyelashes, or even a single eyelash lodged in one of the puncta, may be causing the irritation.

It sometimes happens that a foreign body, lodged under the upper lid, sets up a considerable amount of ophthalmia, and yet the patient is not aware of any such cause of irritation being present. To evert the lid requires a certain amount of tact and practice. A probe, or the feather-end of a pen, just thick enough to resist bending, is to be laid horizontally across the lid, about half an inch from its free margin. The surgeon then grasps with his finger and thumb the eyelashes growing from the middle of the tarsus, and draws the lid away from the globe, while at the same moment he slightly depresses the probe or pen, and tells the patient to look downwards. The tarsal cartilage tilts over and the conjunctival surface of the lid is exposed to view. The foreign body is almost invariably found within a line or two of the tarsal margin.

This simple eversion of the lid appears so obvious a method of detecting foreign bodies, that one fancies it must have suggested itself to surgeons from the very earliest period; and yet, as far as I can discover, it was for the first time made public by Ware, in 1787.[1]

When the surgeon has satisfied himself that the redness of the conjunctiva is not caused or kept up by any mechanical irritation, he is not at once to prescribe a lotion or drops as a mere matter of routine. I shall hereafter have occasion to speak of the invaluable properties of a local stimulant in cases of true *catarrhal ophthalmia;* but at present I am considering those varying forms of conjunctival redness which are described by most writers under the name of *simple ophthalmia.* It is the surgeon's business to note well the general aspect of the patient: to ascertain what is faulty in respect of digestion, general nervous power, condition of the circulation; whether the ophthalmia can be traced to over-use of the eyes, exposure to irritating or vitiated air, want of exercise, excess in the use of stimulants, tobacco, etc.; in short, a rapid survey is to be taken of whatever is faulty in the patient's general health, and, in most cases, when this has been done, and the proper medical and dietetic means have been taken to correct what is amiss, the ophthalmia is already in a fair way of being cured.

[A chronic congestion of the conjunctiva, often accompanied by redness of the margins of the lids, may be kept up by the strain of the accommodation or convergence resulting from some error of refraction.]

As a rule, local congestion of the conjunctival vessels is met with in feeble and languid patients, who require tonics—iron, or quinine, or mineral acids, and a corresponding plan of diet. Of course there are many cases in which an excess of stimulants, and general over-feeding, have disturbed the due balance of the patient's circulation, and where a restricted and well-regulated diet is absolutely essential. But even in such cases a careful and moderate use of tonics is often necessary. What I wish to guard my readers against is the habit, which has been handed down to us from early times, of regarding all inflammations of the eye as necessarily to be treated by depletion, leeches, and low diet. The very reverse of this is the truth. The popular notion that a leech or two to the temples, and a purgative, must needs cut short an attack of inflammation in the eye, is shared by only too many of the old school of practitioners. In young children especially such treatment is most mischievous. From the age of one or two years up to

[1] Remarks on the Ophthalmy, etc., p. 23. I have thought it well to repeat, in this place, directions already given under another head, at page 41.

puberty, ulceration of the cornea is what we have most to fear, and this is sometimes attended with so slight a degree of redness of the conjunctiva and sclerotic, that it is important for the surgeon to be aware of this fact, and not to overlook slight attacks of ophthalmia in such subjects, but in every case to look carefully to the condition of the cornea.

While I so strongly insist on the great importance of general treatment in ophthalmia, I by no means exclude the use of local remedies. Where much intolerance of light exists, a small blister to the temple, or the application of tincture of iodine to the skin of the upper lid, will often afford great and immediate relief. Bathing the eyes night and morning with warm water is of great use in some irritable patients; while, in other cases, the use of cold water is indicated. Those persons especially who have induced a congested state of the conjunctival vessels by prolonged exposure to artificial light, are often greatly relieved by a plentiful sluicing of the closed lids with cold water night and morning. Where there is agglutination of the lids during sleep, a little spermaceti, or perfectly fresh olive-oil, may be smeared on the eyelashes at bedtime. [An ointment of yellow oxide of mercury, gr. j—℥ j, applied to the edges of the lids at the roots of the lashes, is much used.] Weak solutions of acetate of lead or alum (two, three, or four grains to an ounce of distilled water) are useful in chronic cases; but they should be used sparingly, and never for too long a time. After a few days they should be left off, and the part allowed to recover its natural tone, the stimulant being resumed if necessary; but it should never be uninterruptedly continued for weeks or even months, as patients are only too fond of doing.

There are certain forms of ophthalmia which present such distinctive characteristics that they are very properly known by special names. Such are the *Catarrhal*, the *Purulent* (including the *Infantile* and the *Gonorrhœal* forms), the *Pustular*, and the *Chronic*. The disease commonly termed *Scrofulous Ophthalmia* should rather be classed among the diseases of the cornea; and the same may be said of the *Exanthematous* ophthalmia of authors; for it is the cornea which chiefly suffers, either by ulceration or sloughing, in consequence of the low state of vitality following the various forms of exanthematous disease. The term chronic, although of course applicable to any slow and protracted form of disease, when applied to ophthalmia is usually understood to mean an affection of the palpebral conjunctiva, the caruncle and semilunar fold, and the margin of the lids, which is either developed as an independent disease, or remains as a sequela of an acute attack of catarrhal or purulent inflammation.

Catarrhal Ophthalmia.

This is commonly caused by exposure to draughts of cold air, but it is by no means limited to the cold season of the year. It frequently attacks large numbers of persons during the extreme heat of July or August, especially if, as often happens, an east wind prevails at the same time. [Hay-fever patients often suffer very much from this form of ophthalmia.]

A well marked case of catarrhal ophthalmia presents the following appearances: the cornea is quite clear, and vision is unimpaired, or only occasionally obstructed by the passage of thickened mucus across the area of the pupil. The conjunctiva of the lids is redder than natural, and the injection is particularly marked at the point of reflection of the conjunctiva from the lower lid to the globe. The semilunar fold and caruncle are red and much swollen, especially the former, and this enlargement of the semilunar fold often remains long after all other traces of the ophthalmia have subsided. The surface of the globe presents a network of vessels which gradually becomes less marked as it approaches the cornea. In some cases the sclerotic is involved, and then the peculiar pink zone is seen reaching close up to the margin of the cornea.

A peculiar characteristic of true catarrhal ophthalmia is the existence of numerous red blotches at various parts of the network of vessels, caused by some of these having given way and allowed their blood to become extravasated. The extravasations vary much in size; some are as small as a pin's head, others almost equal to the breadth of the cornea.

At the commencement of the attack there is little increase of secretion; subsequently, mucous secretion sets in, which in some cases becomes so profuse as to make the surgeon suspect that the case may be one of true purulent ophthalmia.

There is usually no acute pain in common catarrhal inflammation; but a sense of weight and stiffness in the lids, and, as the disease advances, the enlargement of the vessels suggests to the patient the notion of sand or some other foreign substance between the lids and the globe.

When the sclerotic is much involved, there is usually intolerance of light, and much secretion of tears, and pain either of a dull aching or of an acute darting character. The upper lid, too, frequently becomes œdematous in cases of this mixed

kind of sclerotic and conjunctival inflammation, and the infiltration of the subconjunctival cellular tissue raises the conjunctiva above the level of the cornea, so as even sometimes to overlap its margin. This elevated condition of the inflamed conjunctiva is termed *Chemosis.*

I need hardly say that a patient who is the subject of catarrhal ophthalmia is frequently disordered in general health, with confined bowels and disturbed digestive functions, and may require appropriate treatment by internal medicines; but very often the ophthalmia comes on without any general ailment, and seems a purely local affection, even limiting itself in some instances to one eye.

Treatment.—When the ophthalmia is unattended with constitutional disturbance, and is confined to the conjunctiva, the local application of nitrate of silver in solution may be regarded almost as a specific. It should be used in the proportion of two grains to the ounce of distilled water, and dropped upon the surface of the eye twice or thrice a day, the conjunctiva being cleansed, by bathing it with warm water, before each application of the drops. At bedtime the eyelashes should be anointed with a little spermaceti-ointment or olive oil. Care must be taken not to continue the use of the drops too long. After being used for a week, they may be omitted for a couple of days, and then resumed as before, if the inflammation appears unsubdued; but often it will be sufficient, after a week's application as above described, to use the drops for a few days longer once a day. In uncomplicated cases, ten days or a fortnight will suffice for the cure; but, if the disease spreads to the sclerotic and cornea, the nitrate of silver must be omitted. The caruncle and semilunar fold are the last to recover their healthy condition after an attack of catarrhal ophthalmia. I have said that the treatment by nitrate of silver is to be adopted when the inflammation is *limited to the conjunctiva;* and it is from want of attention to this point that so much mischief is constantly done. Whenever the sclerotic is much inflamed, and, still more, whenever the cornea is in the least degree implicated, nitrate of silver does nothing but harm.

[Applications of nitrate of silver should not be intrusted to patients or their friends without a special caution against their long-continued use, which is liable to result in permanent staining of the conjunctiva. Sulphate of zinc, gr. i—fʒj, alum, gr. iij, and borax, gr. iv or v, are useful applications; or tannin, ʒss or ʒi to fʒj of glycerine, may be applied to the everted lids, and washed off with warm water before the lids are allowed to close.]

Pustular Ophthalmia. [Phlyctenular Conjunctivitis.]

This is a very common form of ophthalmia, especially among children and young persons. It is characterized by little, reddish, aphtha-like[1] elevations on the conjunctiva, close to the edge of the cornea, each surrounded by a plexus of bloodvessels. The centre of the little elevations is less vascular, and therefore whiter, than the base, and hence their appearance is a good deal like that of a pustule; but they do not contain pus, and the term "papular ophthalmia" would be more appropriate than "pustular." When only one or two of these so-called "pustules" are present, they are usually found upon the equator of the eyeball; but sometimes they are more numerous, and almost surround the cornea. They are seldom attended with much pain, or intolerance of light, unless the sclerotic be also inflamed. In true pustular ophthalmia the cornea never suffers, although, from the redness extending close up to its margin, patients are often alarmed at the prospect of the disease affecting the sight.

Vascular elevations similar to those of common pustular ophthalmia sometimes accompany the irritable form of corneal inflammation improperly termed "Scrofulous Ophthalmia." In such cases the intolerance of light may be very great.

Unless there be some derangement of the general health, the treatment of pustular ophthalmia is very simple. A weak solution of acetate of lead—two, three, or four grains to the ounce of distilled water—may be used twice or thrice a day; or, if the inflammation be extensive, and the "pustules" numerous, a blister to the temple should be applied before the lotion is resorted to.

[Acetate of lead is scarcely a safe application, unless the patient can be kept constantly under observation, as, if an ulceration of the cornea should occur, there would be danger of the well-known white deposit caused by lead. It is a question if it would not be better to exclude solutions of lead altogether from the list of collyria, as we have so wide a choice of equally efficient and safer remedies. It is now rarely used in phlyctenular ophthalmia. The local remedies in general use are atropia, calomel, yellow oxide of mercury, and mild astringents. Sulphate of atropia (a few drops three or four times a day of a gr. ii or gr. iv solution) only should be applied while there is very

[1] It was termed by Morgan "Aphthous Ophthalmia."

decided irritation; then fine calomel powder carefully dusted on the pustules once a day, or a piece of yellow oxide of mercury ointment (gr. j–3j), the size of a pin's head, applied to the inner surface of the lower lid. If, as is frequently the case, the phlyctenular is complicated with catarrhal conjunctivitis, alum, borax, or tannin may be required. Blisters are not often necessary, and, in the case of strumous children, are likely to excite troublesome eczematous eruptions.]

Purulent Ophthalmia. [Purulent Conjunctivitis.]

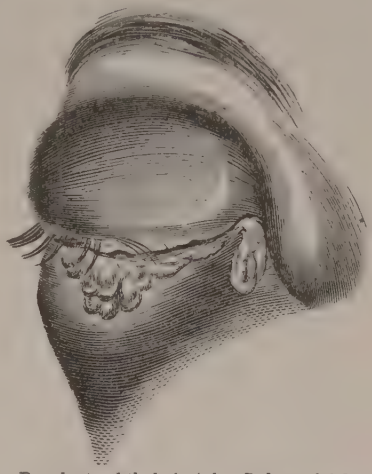
(*Suppurative ophthalmia; Ophthalmo-blenorrhœa; Conjunctivitis puro-mucosa; Ophthalmia contagiosa; Egyptian Ophthalmia; Ophthalmia bellica; Military Ophthalmia.*

On arriving at the consideration of this form of ophthalmia, we must no longer confine our attention to the conjunctiva; for although it is in this tissue that the disease commences, it derives all its importance from the fact that the *cornea* is liable to become involved. Much has been written upon the essential differences subsisting between the common purulent ophthalmia of adults, that affecting infants, the Egyptian, and the gonorrhœal ophthalmia; but these various forms, in certain stages of their progress, often resemble each other very closely, so that a severe case of common purulent ophthalmia cannot be distinguished from one of gonorrhœal origin; and the purulent secretion from the eye of an infant suffering from *ophthalmia neonatorum*, if applied to the eye of an adult, may set up all the phenomena of the truly gonorrhœal form. We must not expect, therefore, to be able in every instance to say with certainty, the first time a patient comes before us, "This is simple purulent ophthalmia;" or "This is of gonorrhœal origin;" we must wait until we have had time to watch the progress of the case.

If a patient presents himself in an early stage of purulent ophthalmia, we may, as I have said, be unable to distinguish the disease from the simple catarrhal form; but should the purulent ophthalmia have reached its height, we should find the following appearances.

The patient is generally pale and depressed; the lids are of a dull red, inclining to purple; they are swollen and œdematous, often to such an extent as to prevent the patient separating their margins in the smallest degree. [Fig. 252.] When the surgeon draws them apart, thick yellow secretion oozes from the conjunctival surface, and if allowed to dry, forms a crust, which almost hides the eyelashes from view. The inability to open the eyes very naturally induces the patient to believe that he is blind, and this belief tends still further to depress him both in body and mind. To separate the lids, to cleanse the cornea from the secre-

[Fig. 252.

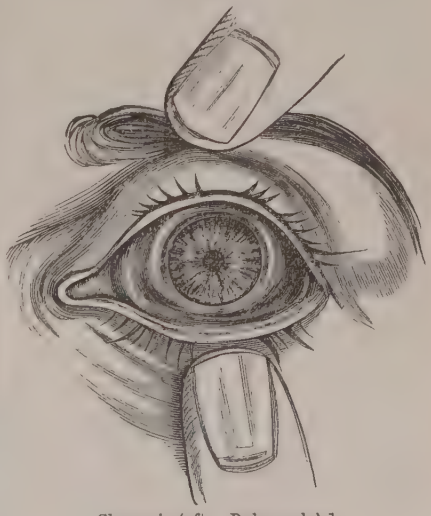


Purulent ophthalmia (after Dalrymple).]

tion which overspreads it, and thus to give the patient a glimpse of surrounding objects, is often the best means of raising his general powers.

In a case of extreme inflammation, such as I am now describing, the conjunctiva covering the globe is reddened, infiltrated with serum, and raised to a

[Fig. 253.



Chemosis (after Dalrymple).]

considerable extent above the surface of the sclerotic. This is especially the case immediately around the cornea, the con-

junctiva being thrown up into a roll which overlaps the corneal margin. This raised condition of the inflamed conjunctiva constitutes what is termed *chemosis*—a very characteristic mark in this and other forms of severe inflammation. [Fig. 253.] In exploring the surface of the cornea, the surgeon should not content himself with merely cleansing it from secretion by means of a bit of wetted lint or sponge; but with a probe or little spatula he should carefully lift up the overlapping portion of the chemosis, in search of any hidden ulcer; for it is at the extreme edge of the cornea that the ulceration sets in, which may eventually go on to perforation.

The milder cases of purulent ophthalmia stop short of the ulcerative stage; and under appropriate treatment the puriform secretion ceases, the conjunctiva gradually loses its unnatural vascularity, and regains its healthy aspect.

The severer cases terminate either in *ulceration* or *slough* of the cornea. The ulceration usually begins, as I have said, at the corneal margin, and as it extends, assumes the form of a more or less deep crescentic groove. Then the ulcer perforates the cornea at some point, and a portion of iris prolapses, producing the appearance of a small dark-colored nodule at the bottom of the ulcer.

Of course any protrusion of the iris must cause deformity of the pupil, which becomes pear-shaped, oval, or reduced to a narrow slit, in proportion to the amount of iris which has escaped through the ulcer. Sometimes the ulceration spreads as a deep groove quite around the margin of the cornea, so as to isolate its central portion, which stands out in relief, cloudy or wholly opaque. Eventually this central portion becomes involved in the ulcerative process, and then the whole cornea becomes thinned, so as to yield to the pressure of the contents of the globe, and forms a bulging mass made up of the remains of the corneal tissue, between the fibres of which dark-colored portions of exposed iris protrude. At a later period the surface becomes traversed by ramifying blood-vessels. This wholesale destruction of the cornea, however, rarely occurs except in cases of gonorrhœal inflammation. Sometimes purulent ophthalmia, instead of inducing ulceration, ends in *sloughing*. In that case the chemosed conjunctiva encroaches a good deal upon the surface of the cornea; the latter becomes hazy, then opaque and yellowish, and quite dull on the surface; at last it looks almost like a piece of wash-leather, then softens and comes away in shreds; the whole iris bulges forwards, and becomes coated with a fibrous exudation, which eventually transforms the part into a *staphyloma*.

Purulent ophthalmia can undoubtedly be transferred from one person to another by contact with the secretion. Patients, therefore, should be cautioned on this point, as also their nurses or attendants. It seems probable that in hot countries, where this ophthalmia is very prevalent, the flies act as propagators of the disease. The dust also of those countries, by keeping the conjunctiva in a state of chronic irritation, no doubt predisposes to the attack. In England the disease, like the common catarrhal form, is, I think, most frequent during the extreme heat which sometimes visits us in July or August, if it be attended, as is often the case, with an east wind.

Treatment.—Although the more rational practice of the present day has effected a vast reform in the treatment of so-called inflammatory diseases, both internal and external, the force of old prejudice and habit has, to a great extent, prevented medical men from applying the same reasoning and common sense to the treatment of eye-diseases which they apply to those of other organs of the body. And, indeed, if a practitioner, unaccustomed to meet with ophthalmic cases, turns in his difficulty to many a work of high authority, published in his own day, he finds such a system of depletion recommended for purulent ophthalmia as is positively frightful. [This treatment may now be considered entirely obsolete.]

Purulent ophthalmia, in its severe form, is usually met with in patients who are irritable, pale, and depressed. And this is almost certain to be the case if the disease be seen at an advanced stage; for the popular notion of the disease, and indeed, of nearly all diseases of the eye, is, that depletion of every kind is the only way to combat them. So true is it, that the vulgar errors of to-day are but the solemn medical dicta of our forefathers.

If the patient's bowels have been well relieved, the first requisite is usually a narcotic at bedtime. I almost always give tincture of hyoscyamus, ℳxxv or ʒss or even ʒj in camphor-mixture, unless the patient has been habituated to the use of opium, when a moderate dose of that drug may be preferable. It is not easy to lay down positive rules for diet, but it should be such as is best calculated to keep the patient's vital powers to the level of ordinary health; as much of plain nutritious food being taken as the stomach can digest, and just such an amount of stimulants as will aid digestion, and maintain the due vigor of the circulation. Quinine is almost always useful in suitable doses. In short, ulceration and sloughing of the cornea should be combated or guarded against, just on the same principles as those destructive pro-

cesses would be combated in any other tissue of the body. To a delicate, ill-fed, over-worked woman, attacked with acute purulent ophthalmia, it may be necessary, in addition to a little beer at her dinner, to order a glass of wine twice or thrice a day. To a person in a comfortable position in life, the ordinary amount of stimulants may be amply sufficient, while, with one habitually intemperate, a considerable diminution of the accustomed quantity may really effect the desired object, by avoiding that after-depression of the nervous system which invariably follows over-indulgence in drink.

The local treatment of purulent ophthalmia consists in the frequent employment of astringents, such as alum, nitrate of silver, or tannin, dissolved in distilled water. The alum may be used in the proportion of eight or ten grains to the ounce, and applied by means of a fine soft rag, every hour during the day, and as often during the night as is compatible with the patient's rest. Where the surface of the globe can be well exposed by drawing down the lower lid, it may suffice to dab the surface of the palpebral conjunctiva and to squeeze the lotion over the surface of the eye from the rag or a fine sponge. If there be so much swelling of the lids as to make it impossible to expose the surface of the globe, the lotion must be injected beneath the lids with a syringe, first throwing in a little warm water to clear away the discharge. As the case improves, the lotion may be used less frequently, every two or three hours. If nitrate of silver be employed, it should be in the proportion of three or four grains to the ounce, and be dropped upon the surface of the globe three or four times a day, after syringing away the discharge with a little warm water. Tannin dissolved in distilled water may be used as a substitute for the alum. In some severe cases which assume the violence of the gonorrhœal form, ulceration rapidly extends along the edge of the cornea—usually the lower edge—in the form of a deep crescentic groove. Unless speedily arrested, it penetrates the thickness of the cornea, and if the opening into the anterior chamber be large, so much of the iris may prolapse as greatly to diminish, or wholly to annihilate the pupillary aperture. In such cases it is sometimes possible to check the spread of the ulcer by rapidly passing over its entire surface a fine point of nitrate of silver. A fine probe, coated with the fused salt, is usually the best means of application.

[The general practice is to use weaker solutions for the frequent applications—from two to five grains of alum, or ten grains of borax. Boracic acid has lately been highly recommended. Some surgeons prefer one or two grains of nitrate of silver. In addition to the weak astringents applied by the attendant, most surgeons apply once a day to the everted lid a stronger solution of nitrate of silver—from five to twenty grains—or the "mitigated stick"—one part of fused nitrate of silver to two parts of nitre—neutralizing the nitrate with warm salt water before replacing the lid. In bad cases, iced water cloths are kept constantly applied to the closed lids. Several pledgets of patent lint or linen should be kept on a lump of ice by the patient's side, that they may be renewed as often as necessary. In cases of ophthalmia neonatorum, hot water applications may sometimes be substituted with advantage. If the palpebral conjunctiva is very much swollen, light scarification is useful; and if there is very great tension of the lids, the outer commissure should be freely divided. The anodyne effect of atropia is always useful, and in case of a central ulcer of the cornea, the dilatation of the pupil tends to prevent prolapse of the iris. If the cornea gives way at the margin, eserine may be substituted for atropia, and it is highly recommended by some authorities on account of its property of diminishing intra-ocular tension. Evacuation of the aqueous humor by paracentesis will sometimes prevent a deep ulcer from penetrating.

A patient in the acute stage of severe purulent ophthalmia should always be kept in bed. The greatest care and watchfulness must be exercised to protect the sound eye from contagion; most surgeons bind it up with compresses of cotton, or seal it with plasters. Any dressing used in this way must be removed twice a day, that the eye may be examined and washed.]

I need hardly allude to the great importance of pure air in the disease now under our notice. In fine weather it is not necessary, even during the acute stage, wholly to confine the patient to the house; and when the ulceration is arrested, and the purulent discharge has ceased, careful and judicious change of air will tend more than anything else to remove the chronic ophthalmia, which is otherwise apt to linger on for a long period.

Gonorrhœal Ophthalmia.

This disease is essentially the same in character as the preceding; but is far more severe and destructive. It is caused by gonorrhœal matter coming in contact with the conjunctiva; and among the more ignorant classes it is sometimes the result of a very prevalent vulgar error—

that a sovereign remedy for sore eyes is to bathe them in the patient's own urine.

I know of no symptom by which we can positively distinguish ordinary purulent ophthalmia from the gonorrhœal form, provided the two diseases are seen at an early stage. Many authors speak of gonorrhœal ophthalmia as almost invariably confining itself to one eye; but this is certainly not the case; and I could relate many instances in which both eyes were attacked within a few days of each other. Indeed, it seems strange that this is not the rule rather than the exception.

Gonorrhœal, like ordinary purulent ophthalmia, begins with redness of the conjunctiva, and a sensation of sand beneath the lids. After a few hours mucopurulent discharge sets in, and the ocular portion of the conjunctiva becomes infiltrated with serum. This thickening rapidly increases and forms a *chemosis*, which is always a very marked symptom in gonorrhœal cases. At the same time the lids become red, and so much swollen that the patient can separate them to only a very slight extent. The cornea becomes hazy, and at this stage an ulcer is almost certain to be found at its margin. Sometimes ulceration begins while the rest of the cornea is still clear; and in that case some care is necessary to detect the loss of substance. A thorough examination of an eye at this stage of the disease cannot be made without the aid of the wire speculum, which prevents the swollen conjunctiva of the lids from bulging over and hiding the cornea. If the margin of the cornea be overlapped by chemosis, a probe or little spatula should be used to hold it aside, while the surface of the extreme edge of the cornea is wiped perfectly clean with a bit of wetted lint or rag.

Patients affected with gonorrhœal ophthalmia are almost always in a state of depression, with weak pulse and deranged digestion. This condition is partly due to the local disease itself, and partly to the distress of mind caused by the fear of impending blindness. It seems extraordinary that surgeons of eminence can have been so far misled by theoretical notions about "inflammation" as to have overlooked the general condition of these patients, and to have treated them by frightful bleedings, mercury carried to salivation, and other depressing means. Those of my readers who may imagine that the so-called "antiphlogistic" plan of treating gonorrhœal or severe purulent ophthalmia belongs to the remote past, need only turn to the works of those who, thirty or forty years ago, were the great authorities of ophthalmic practice, to find that profuse bleeding, mercurialism, and a diet just stopping short of actual starvation, are enjoined as the best means of arresting ulceration and sloughing in the eye; while the very same authorities would have condemned, as *mala praxis*, such treatment of similar morbid processes in the arm or in the leg. One author tells us that "the *only case* of gonorrhœal ophthalmia he had seen in which the eye was saved was that of a young woman, in whom venesection was repeated as often as blood could be got from the arm. She lost 170 ounces of blood in a few days, and looked as if every drop of blood had been drained from her body, the skin having nearly the hue of a wax-candle." One would have thought that the adage, *exceptio probat regulam*, would have occurred to this surgeon's mind, and that he would have regarded a system as self-condemned under which *only one* eye had escaped destruction. But he never seems to have had the slightest suspicion that the system could be wrong.

A second authority quotes, among other cases, the case of a young man who, on the first day, had been bled to fainting, then vomiting was kept up by tartar-emetic as long as it could be borne. In the evening, the pain in the eye had become worse; he was bled again. On the following morning the swelling of the lids was greatly increased, so that the eye could not be seen, and there was copious yellow discharge; the night had been passed in severe pain, which entirely prevented sleep. Bleeding was repeated twice more: blood was taken, by cupping, from the back of the neck and the temple, and leeches were applied around the eye in large numbers; "but although the free use of purgatives and antimonials, with low diet, was combined with these measures, no sensible effect was produced in diminishing the violence of the inflammation, or arresting its progress." Still no misgiving as to the soundness of the system! A third surgeon tells us, that "the lancet must be hardly ever out of our reach; for if ever there was a disease in which blood may be taken away without limitation, it is this." A still later authority, in a bulky text-book, written little more than thirty years ago, says: "You will deem it necessary to bleed at the outset of the attack most freely; it would be almost criminal to stop the flow of blood until your patient exhibited symptoms of faintness; and as soon as he rallies, and the pain returns, the operation should be repeated until syncope is again produced. At the same time you would prescribe a liberal dose of calomel and jalap, so as to act freely on the bowels, and afterwards the tartarized antimony in sufficient quantity to maintain a state of decided nausea. You would also freely scarify the conjunctiva, . . . taking care to divide the texture of the con-

junctiva at each sweep of the knife, so as to penetrate as far as the fluid effused into the subconjunctival cellular membrane. Bleeding from the conjunctiva is to be encouraged. A weak alum-lotion is to be used, and the diet is to be limited to light fluid aliment." An injunction hardly necessary, since one cannot see how a man who has been kept in a state of perpetual nausea is to retain any food at all. But the patient is not to escape with only this amount of depletion. "You would proceed to apply a quantity of leeches just below the tarsal margin of the lower eyelid, and direct the application of a blister between the scapulæ. Lastly, it may be necessary to use tonic and stimulating lotions, . . . and to apply restorative regimen to reinvigorate the reduced powers!" Powers, be it observed, which have been reduced by the surgeon himself. We are to pull the house down, and then try to build it up again.

I may be told, that it is useless to bring forward such cases as these; that the current of medical opinion is changed, and that it now sets strongly against bleeding and depletion, and rather towards a tonic and stimulating plan of treating diseases. I am glad to acknowledge that such is the fact; but, by some strange fatality, the arguments which are allowed to apply to other diseases are still, to a certain extent, ignored so soon as diseases of the eye come to be treated. Some of the works from which I have quoted are still referred to by those who have only occasional opportunities of seeing cases of gonorrhœal ophthalmia, and I cannot therefore think it superfluous to warn my readers against this system of Sangrado-like depletion.

Even Tyrrell, who in his treatment of other diseases laid so much stress upon supporting the powers of the patient, seems in the instance of gonorrhœal ophthalmia to have followed the track of his predecessors as to bleeding. He introduced a new method of scarifying the conjunctiva, which he believed to be destined to effect a total change in the treatment of the disease. It was founded upon the theory that the cornea perished by sloughing; that this sloughing was caused by fibrinous effusion beneath the conjunctiva immediately surrounding the cornea, whereby the vessels supplying the cornea were compressed, and their circulation impeded. He assumed that the cornea derived the whole of its nutrition through bloodvessels passing into it from the conjunctiva, and quite ignored the fact of any vessels passing to it from the sclerotic, and he would have utterly repudiated the notion of there being such a substance in the human body as a non-vascular tissue. The elevated roll of conjunctiva, constituting what is called the chemosis, was to him the great source of danger, and this was to be freely divided by means of radiating incisions, so as to allow the effused fibrin to escape, and the vessels supplying the cornea to be relieved from pressure. The anatomical mistake upon which Tyrrell's practice was founded was well exposed at the time by Wharton Jones.

The fact is, that the cornea, in severe cases of gonorrhœal ophthalmia, does not simply perish by sloughing, in the same way as a tumor strangulated by a ligature perishes. Ulceration first attacks the extreme edge of the cornea, in the manner I have described at page 54, and extends in a crescentic form until a considerable portion of the cornea has been cut off from its nutritive supply, and then of course it loses its vitality. In some cases, I have seen the ulceration extend all round the corneal margin; and then the central isolated portion, having previously become opaque, has rapidly assumed a softened pulpy appearance, and come away in shreds. The chemosis, which has been so much dreaded as the active agent in the destruction of the cornea, is merely formed by the infiltration of serum from the overloaded bloodvessels into the subconjunctival cellular tissue. Of course chemosis is an important symptom whenever it occurs, because it proves a congested condition of the bloodvessels of the conjunctiva, with which there is generally associated a congestion of other more important tissues; but to reduce the patient's vital powers by bleeding, mercury, and low diet, and then to expect to save the cornea by cutting the conjunctiva, appears to be utterly irrational, and opposed to the first principles of physiology and common sense.

In speaking of purulent ophthalmia (page 54) I have anticipated the treatment of the gonorrhœal form. It is quite impossible to lay down positive rules as applicable to all cases. Each case becomes a study in itself, and according to the patient's constitution, habits, station of life, and previous treatment, must the surgeon modify his plan. To maintain the digestive functions, to administer suitable quantities of nourishment, to sustain the circulation at a proper point of vigor, neither unnaturally exciting it to hurried action, nor allowing it to flag, and so lead to local congestion of blood, and consequent deterioration of tissues—to secure as far as possible pure air at an equable temperature, to soothe the nervous system, and promote sleep by such mild narcotics as shall not confine the bowels or induce subsequent depression—such is the outline of the general treatment to be pursued.

The local applications I have already indicated at page 55, only I would lay still greater stress, in cases of gonorrhœal ophthalmia, upon the utility of nitrate of silver, applied in substance to the surface and edges of the crescentic ulcer. Unless this application be made with great care and neatness of hand, it may do more harm than good. A stick of nitrate of silver can hardly be pointed so sharply as to answer the purpose, and a fine probe, upon the end of which a small portion of the salt has been fixed by fusion, is to be preferred. The lids being held apart with a wire speculum, and the edge of the cornea having been wiped clean, the fine point of nitrate of silver is to be lightly passed over the whole surface of the ulcer. This application may require to be repeated after a couple of days, but should not be persevered in after the ulceration has ceased to spread.

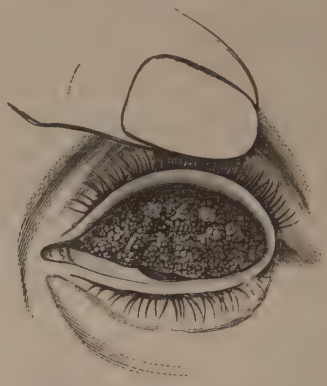
In spite of all our efforts and care, it must frequently happen that cases of gonorrhœal ophthalmia terminate in loss of sight. For the disease often occurs in unhealthy subjects, weakened by intemperance and debauchery, and who, before they apply to a regular practitioner, have probably been in the hands of quacks, whose only remedy is mercury. Still, when we consider of what immense importance it may be to retain even a small portion of the cornea in a transparent condition—thereby enabling the surgeon at some future time to make an artificial pupil, and so rescue the patient from blindness—we ought never to give up a case of gonorrhœal ophthalmia so long as any portion of the cornea retains its vitality.

Granular Conjunctiva.

(*Granular Lids; Trachoma.*)

One of the most serious sequelæ of purulent ophthalmia, whether of the simple or the gonorrhœal form, is that condition of the conjunctiva termed "granular," involving a hazy and vascular state of the cornea. During the progress of purulent ophthalmia, the palpebral conjunctiva, when cleansed from secretion, appears villous; and, after the purulent discharge has ceased, this condition of the membrane goes on increasing, until its surface resembles that of a granulating ulcer [Fig. 254]. The so-called "granulations," however, are in reality the follicles and papillæ of the conjunctiva, enlarged by inflammatory deposits. The firmness and solidity of these "granulations" vary much in different subjects. When hard, and of considerable size, they cause irritability and blinking of the lids, and lacrymation, and after a time the cornea, especially its upper half, be-

[Fig. 254.



Granular lids (after T. W. Jones).]

comes hazy, and is traversed by numerous large vessels, forming in some cases a complete network, and giving an almost fleshy aspect to the part (*pannus*).

[The condition of the palpebral conjunctiva in purulent ophthalmia affords a good example of what Stellwag calls "papillary trachoma," in which the so-called granulations are simply hypetrophied conjunctival papillæ. The "true granulations," however, of "granular trachoma" are neoplastic formations involving the submucous tissue and causing, by their contraction, the cicatricial condition and distortion of the lids so much dreaded by ophthalmic surgeons. These two forms of granulations frequently exist together.]

Treatment.—The granulations were long since recognized as causing by their friction the chronic inflammation and vascularity of the cornea; and accordingly a great variety of plans have at various times been adopted for removing the granulations, and restoring smoothness to the palpebral conjunctiva. Complete excision with the knife or scissors, the rapid action of escharotics, and the more gradual wasting by means of astringents, have all in turn been employed against granular lids.

Effectually to cut away the granulations requires such extensive removal of the palpebral conjunctiva as is likely to induce permanent curving of the tarsus and consequent entropion; and the same result may follow the free employment of nitrate of silver. The ordinary astringent lotions of alum, tannin, etc., are powerless in the more severe cases. I have seen much benefit from the acetate of lead, applied by dusting it, in fine powder, over the everted lid. This causes a good deal of pain at the time, but afterwards gives decided relief, apparently by mechanically

filling up the interstices of the elevations, and so producing a smooth surface for the eyeball to move upon. The salt, as it slowly dissolves, seems also to exert an astringent effect upon the vessels of the enlarged follicles and papillæ, and so to diminish their bulk. But the most effectual means I have ever tried for removing granulations is the undiluted liquor potassæ, applied by dabbing it upon the everted lids, on which it seems to act by chemically saponifying and dissolving away hypertrophied tissue. The application may be repeated at intervals of a few days; and six or seven weeks of this treatment will sometimes suffice to remove the granulations, and, at the same time, to restore a considerable degree of clearness to the cornea.

[This severe practice is unusual. The efforts of the surgeon are directed rather to promoting the absorption of the granulations than to removing or destroying them by mechanical or chemical means. The best applications for this purpose are solutions of nitrate of silver, of from two to twenty grains to the ounce, the "mitigated stick" (see p. 55), ʒss or ʒj of tannin to f ℥j of glycerine or water, and the crystal of alum or sulphate of copper. They should be applied to the everted lid, daily or two or three times a week, and the surface washed with warm water before being allowed to fall upon the cornea. Where strong applications of nitrate of silver are used, it is well to neutralize it with salt water. When the palpebral conjunctiva is thickened and "velvety," light scarification is useful.]

But, every now and then, cases are met with in which the cornea is so opaque, and so traversed by large bloodvessels, as to prevent useful vision, even when the granular state of the lids has been almost subdued. Such instances of opaque and vascular cornea follow severe purulent ophthalmia, especially the form so common in the East, and known to us as Egyptian ophthalmia. Cases of almost equal opacity are met with at our London hospitals, among the more destitute Irish patients. It appears that a very severe form of purulent ophthalmia is sometimes epidemic in certain districts of Ireland, rivalling in virulence the disease of tropical countries.[1]

Patients who have been a long time suffering from granular lids in a severe form are almost invariably out of health; often reduced by the violent courses of medicine they have undergone, and with the eyes in an irritable condition from long-continued use of caustic applications. To place such patients, if possible, in a pure and bracing air, and to improve their general health by suitable tonics, will be the first indications for treatment. Caustics and stimulants should be laid aside, and counter-irritation employed by means of small blisters to the temple, and tincture of iodine to the skin of the lids. In this way considerable improvement may be induced both in the condition of the lids and of the cornea; but there will still remain certain inveterate cases, incurable by any ordinary treatment, either local or general. They usually present a granular condition of the palpebral conjunctiva; this, however, may have been got rid of, or greatly subdued, by treatment; the characteristic sign, which makes the disease so formidable, is the haziness and vascularity of the cornea.

We will suppose a case in which the granular condition of the lids has been partially or wholly cured, and the general health restored; but where, after exhausting every resource of his art, the surgeon still finds the patient's cornea permanently opaque, and traversed in all directions by vessels, vision being limited to the mere recognition of large objects. There may be every reason to believe that the tissues of the eye posterior to the cornea still remain healthy, and yet the condition of the latter destroys all hope of good vision being regained.

For such desperate cases a seemingly desperate remedy—*inoculation*—has been proposed, consisting in the production of a fresh attack of purulent ophthalmia, by applying to the conjunctiva some morbid secretion from the eye of a patient suffering under the acute form of that disease.

This treatment was extensively tried in Germany several years ago, but seems to have fallen into disuse, and only of late to have been revived. Its advocates asserted that purulent ophthalmia, thus produced in an eye which had previously undergone the disease, would cause a wasting of the vessels overspreading the cornea, and ultimately restore its transparency. There seemed, however, a great risk of the second attack proving as severe as the first, and ending in destructive ulceration of the cornea; and the fact of the inoculation serving to keep up and perpetuate a dangerous and contagious disease, also operated with many surgeons as a reason for wholly discountenancing the practice. These considerations for some time induced me to abstain from the experiment. I had seen cases in which inoculation was followed by perforating ulcer of the cornea; but, at the

[1] Power, in a pamphlet on the Egyptian Ophthalmia, published in 1803, describes a species of the same disease as being "frequently prevalent among the Irish peasantry, and considered by them to be infectious." See also a paper by Wilde in the London Journal of Medical Science, vol. iii., 1851.

same time, I had seen others in which considerable clearing of previously opaque corneæ took place without any ulceration whatever.

The first case in which I tried inoculation was one which seemed peculiarly suitable for it. The patient, a discharged soldier, was in good general health, but quite helpless in consequence of the state of his corneæ. They were so hazy that the position of his pupils could not be traced, and were traversed in every direction by vessels. He had perception of reflected light and colors, but could not distinguish a hand from a sheet of paper, except by the difference of tint. Although the granular state of the lids had been nearly subdued, the condition of the corneæ during three years had been proof against every mode of treatment.

Some pus from the eye of a patient with purulent ophthalmia was applied to each conjunctiva. Intense inflammation set in, and on the third day there was already chemosis with thick purulent discharge. A week later, both corneæ were so covered with a yellowish flocculent layer as to appear to be in a state of complete slough. This substance, however, in the course of a few days, had disappeared, and the corneæ were found to be entire, presenting a somewhat translucent aspect, although the chemosis and discharge still continued. As no local application except cold water was permitted, and no astringent used to control the discharge, it continued in a slight degree for some months. Meanwhile the corneæ, as they became clearer, presented but few traces of the vessels by which they had been so plentifully traversed. Six months after inoculation, the patient could recognize features at a distance of twelve feet, and with perfect security could go about the streets of London alone. There still remained such a degree of haziness about the centre of each cornea as prevented him from reading ordinary type, No. 16 of Jæger's specimens being the smallest characters he could readily make out.

I have since used inoculation repeatedly, and so many cases have been reported by others, that I should not have quoted this single case, except on account of its bearing upon a point which I think has not been sufficiently attended to, namely, the varying results of inoculation in respect of its inducing corneal ulceration.

The vitality of the cornea is put to a very severe test when the suppurative inflammation sets in with such intensity as is exemplified in the case just mentioned. If the cornea be abundantly supplied with blood by vessels traversing it in every direction, it will probably resist both ulceration and sloughing; whereas, a simply opaque and non-vascular cornea may be destroyed, or at least perforated, on account of mere deficiency of blood-supply. The abundant vessels which had prevented the cornea duly performing its function of transmitting light, serve to keep it alive while the inflammatory stage is going on, and so enable it eventually to recover its transparency and usefulness. The very circumstance, therefore, of the cornea being in a hyperæmic condition is favorable, as regards its ability to support the violent means employed for the restoration of its transparency.

Those who for the first time resort to inoculation in a case of corneal opacity, resulting from bygone purulent ophthalmia, will probably be dismayed when they witness the immediate result of their experiment; and will give up the cornea for lost when they see it overlapped and nearly hidden by chemosis, and catch a glimpse of its dead-yellow, slough-like surface. This, however, becomes detached, and leaves beneath it a translucent cornea, which, provided it has been well nourished with blood, may gradually advance in clearness, until it almost loses the marks of its former degeneration.

Throughout the treatment no attempt is to be made to arrest the discharge, cold water only being used as an external application in cleansing the eye. The patient should be allowed a nutritious diet, and on no account undergo depletion.

Even under the most favorable conditions, as regards the patient's general health, and the blood-supply of the cornea, inoculation must be a hazardous experiment; and it should, therefore, be reserved for those cases where the vascular opacity of the cornea has bidden defiance to all other forms of treatment, and has deprived the patient of all useful sight.

Purulent Ophthalmia of Infants.

(*Ophthalmia neonatorum.*)

This disease is closely allied in its symptoms to that just treated of, although not arising from the same specific form of infection.

Both diseases derive all their importance from the liability of the *cornea* to become ulcerated. The cause of *ophthalmia neonatorum* has given rise to much controversy; some regarding it as only an aggravated form of catarrhal ophthalmia, while others consider it as in every case due to contamination with the vaginal discharge of the mother. The latter is perhaps the more probable explanation, the difference in the intensity of the disease depending upon the more or less virulent nature of the discharge.

The ophthalmia begins a few days after birth. It may not for some time assume any intensity, and hence it is often over-

looked in its early stage ; and we are told that it did not begin till the child was two or three weeks old. When the child is jaundiced, the discharge assumes a deep yellow color.

The surgeon's first object should be to ascertain to what extent the corneæ are involved. Having secured the infant's head between his knees, he should carefully introduce between the lids a wire speculum, of a size and strength of spring proportioned to the small palpebral opening of so young a child. [The cornea can generally be exposed by the fingers, without the use of a speculum, which is very painful.] With a bit of moistened lint the discharge should be gently wiped away, so that the surface of the cornea may be thoroughly explored.

If an ulcer exists, it will most commonly be found at the centre. It may occupy the whole area of the pupil, or involve all the cornea except its extreme edge, or the iris may be seen protruding through a complete perforation of the cornea in the form of a brownish nodule. If the whole cornea be destroyed, the iris will be seen bulging forward, covered by a thin glaze of semi-transparent inflammatory deposit. Sometimes it seems as if the posterior elastic lamina had resisted the ulcerative process, and still formed a thin coating to the bulging mass of iris. These are the cases which eventually exhibit *staphyloma;* the deposit upon the iris becoming by degrees thicker and denser, and assuming very much the appearance of opaque, or partially opaque, corneal tissue, over the surface of which, at a later period, arborescent vessels ramify. When the perforating ulcer of the cornea is very large, it not uncommonly happens that the lens escapes through the aperture.

When the purulent ophthalmia is at its height, the lids are red and swollen ; but when the cornea has given way, the bright rosy tint of the lids usually gives place to a dull livid color, the swelling subsides, and the skin becomes flabby. The palpebral conjunctiva, when cleansed from the discharge, appears bright red and villous.

Treatment.—The nutrition of an infant attacked with purulent ophthalmia is so important—as the means whereby the ulcerative process may be averted, or, if that process have already commenced, reparative material may be supplied for filling up the breach—that, before alluding to local treatment, I would insist upon the importance of the child being suckled, and not brought up by hand. A weakly infant, attacked with severe ulceration of the cornea, and fed with artificial food, has hardly a chance of recovery. Of course the condition of the bowels must be attended to ; but care must be taken not to lower the child by unnecessary doses of "gray powder"—that panacea for infantile complaints, according to popular belief. Weakly children are often benefited by a few drops—four or five—of Battley's liquor cinchonæ, given in a teaspoonful of milk twice a day.

In the local treatment, all depressing and so-called "antiphlogistic" measures are to be carefully avoided. Blistering is perfectly ineffectual towards controlling the discharge, and only weakens and irritates the general system. Abstraction of blood by leeches is even worse, as depriving the child of that reparative material which is so urgently required for averting or healing ulceration. I know of no application better than a solution of alum—five, eight, or ten grains to the ounce of distilled water—which should be injected between the lids every half hour. It is well to inject a little warm water before using the alum-lotion, so as to wash away the discharge, and thus allow the alum to come completely into contact with the inflamed conjunctiva. [See page 55.]

As the discharge abates, the lotion may be injected less frequently—every hour, or every two hours. Care must be taken not to chill the infant by wetting its clothes during the injecting.

The condition of the cornea must be carefully inspected from day to day. If there be a large ulcer, and the reparative process have set in, the surgeon must not be uneasy on observing that the surrounding portion of the cornea looks cloudy and reddish. This pink tinge is owing to the presence of bloodvessels, advancing towards the ulcer, and conveying to it reparative material. When the ulcer has become completely filled up, these bloodvessels will gradually disappear, and the peripheral portion of the cornea, in which they ramified, will resume its transparency.

Sometimes it is useful to change the local application, and to use a solution of nitrate of silver—two grains to the ounce—dropping a small quantity on the conjunctiva twice or thrice a day. This change of stimulus often acts beneficially, when the puriform discharge has almost ceased, and the ulcer still shows little disposition to heal. As soon as the ulcer begins to fill up rapidly, the alum or nitrate of silver should be used less frequently.

In severe cases of purulent ophthalmia, eversion of the swollen conjunctiva of the lids frequently occurs. This always gives rise to alarm among those who have charge of the child, and is often a cause of anxiety to the surgeon. It is a matter of no real importance ; the eversion cannot be controlled by any artificial means, and is sure to cease as soon as the puriform discharge has abated.

"Scrofulous or Strumous Ophthalmia."

(*Phlyctænular Ophthalmia.*)

If by "ophthalmia" we are to understand an inflammatory affection of the *conjunctiva*, this disease ought not to be termed ophthalmia at all. It is essentially a corneal disease, the conjunctiva being only secondarily affected, and I have therefore transferred it to the chapter in which Diseases of the Cornea are described. [See page 52.]

Chronic Ophthalmia.

The acute stage of common catarrhal ophthalmia, if neglected, is apt to subside into a chronic form, characterized by a congested state of the palpebral conjunctiva, with an increase in its mucous secretion, an unnatural fulness of the caruncle and semilunar fold, and some degree of redness along the tarsal edges. The patient complains of a sensation like that produced by a small foreign body beneath the lids; luminous bodies appear surrounded by a halo of prismatic colors; the eyes water when exposed to bright light or cold winds; and the lids are gummed together in the morning.

The surgeon, on first seeing such a case, should most carefully explore the edges of the tarsi, to see if any fine eyelashes are growing irregularly, so as to touch and irritate the globe. A single delicate hair, so fine as almost to elude observation, will sometimes suffice to keep up, or even of itself to produce, most of the symptoms I have just described.

Chronic ophthalmia, characterized by the above symptoms, is not always a sequela of acute inflammation. Indeed, it more commonly occurs as a primary disease, in persons whose occupations oblige them to sit for many hours in close and overheated rooms, while engaged on minute objects, especially under artificial light.

Treatment.—When we consider the various classes of persons liable to chronic ophthalmia, it is obviously impossible to lay down rules of treatment which shall be universally applicable. To rectify whatever may be found amiss in the general health, is the first indication. The injurious effects of artificial light chiefly depend upon the abundance of red [yellow] rays inseparable from every form of it. These may be modified by adapting to the flame of the lamp, or gas-burner, a chimney or shade of transparent glass, slightly tinted with blue. The color should be so faint as only just to whiten the flame, without imparting to it any decidedly blue tinge.

An immense variety of substances has been used in lotions and drops for the cure of this troublesome affection. Acetate of lead, alum, sulphate of zinc, nitrate of silver, sulphate of copper, tannin, etc., have all found their special admirers. Vinum opii was long a favorite form of drop; while the more homely washes of diluted brandy or vinegar have found favor as domestic remedies. Whatever form may be preferred, care should be taken not to make the solution too strong, and not to use it for too long a time without intermission. The object should be to stimulate the conjunctiva for a short period, and then to give it time to resume its natural functions. Many persons, by the habitual use of strong lotions, keep up the very condition they are seeking to cure. Acetate of lead [see page 52], or alum, in the proportion of from two to four grains in the ounce of water, are perhaps as useful as any of the more common substances. Bathing the eyes in cold water, night and morning, is in many cases preferable to the use of any medicated lotions. An occasional small blister to the temple is useful when the eyes become suddenly irritable and intolerant of light.

Injuries of the Conjunctiva.

The more serious of these are due to contact with escharotics, heated fluids, or melted metal. Slight lacerations or cuts of the conjunctiva, not involving the sclerotic, require only very simple treatment—water-dressing and closure of the lids. Strong mineral acids, caustic alkalies, and other chemical substances, often produce the most destructive effects upon the conjunctiva and cornea, causing bands of adhesion to form between the lids and the globe, and inflicting upon the cornea such an amount of opacity as wholly to destroy sight. The damage in these cases is so instantaneous that the surgeon has hardly ever the opportunity of neutralizing the destructive fluid. If at hand at the moment of the accident he would of course at once inject between the lids such a fluid as would chemically decompose the acid or caustic alkali, and form a neutral salt. Afterwards a little castor oil or olive oil may be dropped upon the surface of the globe, and water-dressing applied over the closed lids.

When melted metal has spurted into the eye, the surgeon should always evert the upper lid, and explore all the folds of the conjunctiva; for large portions of metal will sometimes lodge beneath the lids in the most singular manner, and re-

main there quite unsuspected for a long time.

When lime, mortar, sand, or other solid matters, have been thrown against the eye, the upper lid must be everted, and every particle of grit removed in the most careful manner with a small scoop. In such cases it will not do to trust to injections of water only, although they may be useful after the scoop has done its work.

If the surface of the conjunctiva presents an opaque thickened appearance, as if it had been boiled, and the cornea is also of an opaque and pearly hue, the damage to sight is irreparable, and only slight improvement is to be hoped for. In such cases the surgeon must take care not to weaken the patient by bleeding or low diet, for it is by keeping up the patient's reparative power that the life of the corneal fibres is to be sustained, and sloughing averted. Where a portion of the cornea is densely white and opaque, and the rest only slightly cloudy, the latter part may recover much of its natural transparency.

In those cases where the opposed surfaces of the palpebral and ocular conjunctiva have sloughed, it is impossible to prevent the formation of bands of adhesion; but these may be somewhat limited by the frequent use of a probe, to break down the newly-formed granulations.

Affections of the Subconjunctival Tissue.

Œdema.

Pressure upon the trunk of the ophthalmic vein or its branches, by obstructing the return of blood from the conjunctiva and subjacent areolar tissue, is liable to produce œdema. In slight cases the œdema is confined to the lower part of the globe, where the distended conjunctiva sometimes overhangs the edge of the lower tarsus; it is only in extreme cases that the œdema extends to the upper part of the globe. In old persons, whose tissues are very lax, I have seen the margin of the cornea overlapped by the œdematous conjunctiva.

Œdema and chemosis only differ in degree; the former being a mere exudation of serum in consequence of pressure on the veins leading from the part, while the latter term is restricted to those cases where the conjunctiva and subjacent areolar tissue are actively inflamed. Abscess in the lids or in the lachrymal sac, tumors and exostoses in the orbit, periosteal thickening in the neighborhood of the ophthalmic vein—in short, any direct pressure on this vessel, may give rise to œdema, which cannot therefore be regarded as of itself constituting a disease, or as demanding attention, except as a symptom of something more important which has given rise to it.

Ecchymosis.

Some of the small vessels beneath the conjunctiva may give way in consequence of a violent effort, such as coughing or vomiting, or sometimes without any assignable cause; in children with whooping cough such extravasation often takes place to a great extent. The blood may appear as a small patch on the white of the eye, or it may quite hide the sclerotic, and extend up to the edge of the cornea. The appearance is so peculiar that it can never be mistaken for inflammatory injection. In the latter the individual vessels can always be distinguished, while the extravasation presents the uniform aspect of a thinly spread-out clot.

Subconjunctival ecchymosis not uncommonly causes great alarm to the patient; but, except for its unsightliness, it is quite unimportant. The scraped root of the black bryony (*Tamus communis*) made into a poultice with bread crumbs or linseed meal, applied over the closed lids, and renewed every six hours, will hasten the absorption of blood. If this cannot be worn, frequent sluicing with cold water is the best thing to be done. Nothing, however, will cause the blood to be absorbed until after the lapse of several days.

Pinguecula.

After the middle period of life, especially in persons who have been much exposed to the weather, or have lived in hot climates, it is very common to see small yellowish elevations on the sclerotic, close to the edge of the cornea, and on the equator of the eyeball. They are sometimes surrounded and traversed by a few fine vessels. When these little elevations attain their full size, they will be observed to have a somewhat triangular form, the base corresponding to the cornea. They have received the name of *pinguecula*, from their being supposed to consist of fat; much of their bulk, however, is made up of fibrous tissue. Pinguculæ are growths so entirely harmless that they would not call for a remark, were it not that they very often give rise to the most serious alarm in the patient, who believes that they will gradually grow over the pupil and obstruct the sight. An explanation of their real nature comprises all that is required on the part of the surgeon.

PTERYGIUM.

This consists in a reddish, fleshy-looking growth extending from the semilunar fold to the cornea, the margin of which it frequently oversteps. It has a triangular shape, its base corresponding to the inner canthus. Slighter forms of this growth are met with, in which, instead of looking like a portion of muscle, the fibres are so thin and delicate as rather to resemble an aponeurosis with a few muscular fibres intermixed. No muscle, however, is found in these growths, which consist of fibrous tissue abundantly intermixed with blood-vessels. [See Fig. 255.]

[Fig. 255.

Pterygium (after Guthrie).]

Pterygium, like pinguecula, is found in persons past the middle period of life, and especially among those who have lived in tropical countries. The dust, which is there so abundant, may probably be an exciting cause. A very well-marked case came under my care in a mason and plasterer, who, although always residing in the neighborhood of London, had of course been much exposed to dust of various kinds. The largest pterygium I ever saw, however, was in a countryman from Essex, in whom the apex of the growth, instead of stopping short of the area of the pupil, as is commonly the case, spread so far across the cornea as almost to hide the whole of the pupil. In this case I removed the growth; and whenever the apex extends so far as to occupy a large portion of the cornea, the deformity it produces may demand an operation. The lids being held asunder with a spring speculum, the lax portion covering the sclerotic is to be nipped up in a forceps, and cut across with a fine scalpel midway between the edge of the cornea and the semilunar fold. The portion extending towards the cornea may then be dissected off the sclerotic, great care being taken when that part is removed which adheres to the cornea. It is well not to remove the inner third of the pterygium, as otherwise the semilunar fold and caruncle are apt to retract, which afterwards gives an unpleasant prominence to the eyeball.

[It is better to begin by dissecting the point of the pterygium carefully from the cornea, with a Beer's knife; then with scissors to follow the edges of the conjunctival portion for about two lines, and from these points to make the incisions meet by converging them. The edges of the conjunctiva are then brought together with fine sutures. The rhomboidal form of the wound made in this way admits of a much neater and smoother union than the triangular form of the old operation, and is less likely to be followed by a thickened cicatrix.]

No other local treatment than removal with the knife or scissors is of any avail in getting rid of a pterygium. Stimulating lotions and drops only excite it to grow; and the varieties of pterygium described by authors, under the names of *sarcomatous*, *fungous*, *cancerous*, and *malignant*, were probably nothing more than common forms of the growth, irritated and teased by escharotics.

FATTY TUMORS.

Fatty deposits to any large extent beneath the conjunctiva are uncommon. The few cases I have seen occurred in children, and the tumors all occupied the same position, namely, the line of reflection of the conjunctiva from the lower lid on to the globe. They extended from near the lower edge of the cornea to the outer canthus, were of an elongated form, almost resembling a haricot bean, and were partly concealed by the lower lid. On dividing the conjunctiva and the proper fibrous envelope, the fatty mass was easily turned out.

CYSTICERCUS TELÆ CELLULOSÆ.

This parasite is occasionally found in the subconjunctival cellular tissue, but it appears to be of very rare occurrence. I have seen but two instances, both in females, one patient being six, the other eighteen years old. The appearance was that of a rounded body, about as large as a pea, midway between the inner canthus and the cornea. There was a good deal of vascularity in the conjunctiva covering and surrounding it. In the first case a little watery bladder, rather larger than a pin's head, had been observed about eighteen months before the patient was brought to me. In the second case, no

account could be given as to the first appearance of the growth. On the conjunctiva being divided, the cysticercus slipped out, and was at once recognized under the microscope. Sichel, in his Iconographie, gives a very good figure of a cysticercus in the position I have described (Pl. lxxii., fig. 2), and also of one developed beneath the plica semilunaris (fig. 1). In other figures of the same plate, the animal is shown both in its natural size and magnified.[1]

At the time I saw these two cases the connection between the development of tænia in the intestines, and of cysticercus in other parts of the body, had not been pointed out; nor was it suspected that two creatures so dissimilar were really the same animal under different forms of development.[2] [Dermoid tumors are sometimes met with at the corneo-sclerotic junction. They are generally congenital, and may contain one or several hairs. Other rarer affections of the conjunctiva are warts, cysts, sarcoma, epithelioma, and syphilitic ulcers. The latter, though rare as involving the conjunctiva alone, are not uncommon at the margin of the lower lid, where they involve both skin and conjunctiva.]

STAINS FROM NITRATE OF SILVER.

Before quitting the subject of affections of the conjunctiva and subjacent tissue, I may say a few words respecting the serious disfigurement which results from the prolonged use of nitrate of silver in solution. No surgeon who understands the real action of this substance—its invaluable efficacy in catarrhal ophthalmia, and its inutility or injurious effects in affections of the cornea—would be likely to employ it in such a manner as to produce permanent staining of the tissues of the eye; for in no case is its prolonged use of any service; the good it does, it does in a few days. Patients, however, have such unbounded faith in the efficacy of eye-drops and eye-waters, that they will frequently continue the use of them for months, and even years.

One of the worst cases of staining with nitrate of silver I ever saw came under my notice only a short time ago. A woman, with incurable opacity at the centre of the cornea —the cicatrix of an ulcer, in fact—had been ordered to use drops of nitrate of silver. This she did for some months, under a surgeon's advice. She then went to another part of the country, but still continued the use of the drops, putting in, as she assured me, "two drops every day for *ten years*." The whole of her sclerotic was of a dirty sepia tint, most marked towards the lower part of the globe. The cornea itself slightly partook of the same tint, and the conjunctiva of the lower lid, thickened and vascular, looked as if a brush dipped in liquid sepia had been passed over it, the dull red color of the conjunctiva being only seen where the membrane had formed a fold.

In another case, where this discoloration existed in a less marked degree than in the case just mentioned, I tried the effect of a solution of cyanide of potassium. The patient was an intelligent man, and could thoroughly understand the principle of the treatment, which was to keep the whole surface of stained tissue for a lengthened period in contact with the fluid. This was effected by the help of an "eye-glass," and I told the patient to draw down the lower lid, and to fix it against the cheek-bone with the rim of the glass, before throwing his head back. After several months but little benefit had resulted, and I then tried a solution of hyposulphite of soda, beginning with a strength of ten grains to the ounce of water—as the effect of the substance was unknown to me—and gradually increasing it up to a drachm to the ounce. The change effected was very slow, but when I last saw the patient the stain was barely traceable on close inspection.

CHAPTER IV.

DISEASES OF THE CORNEA.

Thoroughly to appreciate the slight changes in the cornea which are capable of affecting the sight, the surgeon should clearly understand that the normal condition of the part consists in absolute transparency of its whole thickness, and perfect polish of its surface; every deviation from these conditions is an evidence of some morbid action.

When a healthy eye is examined near a window, the image of the window-frame ought to be depicted on the surface of the cornea with the most perfect sharpness and clearness of detail. A slight amount of inflammation, just enough to cause some thickening of the epithelium, destroys the brilliant polish, and causes the image of the window to appear blurred and dull, and the lines of the sash-bars crooked and wavy. This appearance is often important as giving notice that inflammation of other tissues of the eye

[1] Græfe mentions five cases of subconjunctival cysticercus as having occurred in his *clinique*, during a period of thirteen years. Archiv für Ophthalmologie, xii., 2, 174.

[2] See Küchenmeister, On Animal and Vegetable Parasites of the Human Body; and Von Siebold, On Tape and Cystic Worms; published by the Sydenham Society, 1857. See also the essay on Parasites in Vol. III.

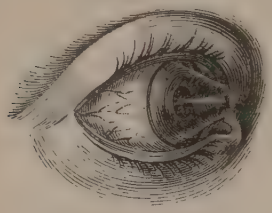
may be going on ; as in the early stage of glaucoma, where this dull condition of the epithelium is always to be seen.

Conical Cornea.

(*Hyperkeratosis*—the tissue of the cornea being erroneously supposed to be in excess ; *Staphyloma corneæ pellucidum; Keratoconus.*)

This curious and rare[1] malformation consists in a change in the form of the cornea from a segment of a sphere to a cone, the transparency of the part remaining unaltered. There seems to be

[Fig. 256.



Conical cornea (Wells).]

no peculiar constitution which predisposes to the affection. It is met with in both sexes ; in persons apparently of good general health, as well as in the delicate and sickly : nor have I ever observed that any special employment, or mode of life, could be traced as the exciting cause.

The aspect of a patient with conical cornea is so peculiar, that when once seen, the affection can never afterwards be overlooked. The eye, viewed in front, has a brilliant and sparkling appearance, as if a tear were hanging just in front of the pupil. When seen in profile, the conical shape of the cornea is at once recognized. The position of the iris is unchanged, and its movements are perfectly natural ; nor is any other tissue, except the cornea, observed to be affected. In saying that a conical cornea is perfectly transparent, I should modify the remark as far as concerns the extreme apex of the cone, which sometimes, when viewed closely, presents an appearance of slight opacity. In some cases this seems due to an actual haziness in the tissue itself ; but the appearance is frequently caused by mere refraction of the rays of light. There seems no good reason for attributing this slight cloudiness of the apex of the cone to the friction of the lids.

[1] That the disease is very rare may be seen by reference to a table which I contributed to the London Journal of Medicine (vol. ii., 1850), showing the number of cases of conical cornea occurring among the patients annually received at the Moorfields Hospital from 1819 to 1849.

The apex of the cone almost always corresponds to the centre of the cornea ; but in very rare cases it has been observed to deviate from this position. The deformity usually begins when the patient is between twenty and thirty. At first he grows short-sighted, but as the change goes on, a remarkable refraction of the rays of light is produced ; the flame of a candle appears surrounded with a halo, then it seems to be divided into a multitude of diverging rays, and sometimes, instead of a single flame, several flames are seen, arranged in a circle. When the last stage of conical deformity has been reached, the patient cannot read, even at the shortest focus.

In the few cases in which conical corneæ have been dissected, the apex of the cone has been found very much thinned. The mode in which the disease originates is at present quite unexplained ; and in proportion to the obscurity which attends its cause have arisen the most varied suggestions for its treatment. Repeated evacuations of the aqueous humor, the same operation followed by pressure on the cornea, removal of the lens by extraction or solution,—these, and perhaps other forms of operation, were formerly tried, but without benefit.

About thirty-three years ago, Tyrrell tried the effect of displacing the pupil towards the corneal margin. With the blunt hook he invented, he drew out a small piece of the iris, and cut it off, leaving a portion of the cut tissue entangled in the wound. His object was to bring the pupil opposite the flatter portion of the cone ; but the result did not answer his expectations. A better form of this operation has been lately devised, whereby the pupil is transformed into a long narrow chink, reaching quite across the cornea. A small wound is made close to the corneal margin, a blunt hook or fine forceps is introduced, and the pupillary portion of the iris, having been drawn out, is tied with a fine ligature. (See *Iridodesis.*)

At a later period, when the corneal wound is healed, and the aqueous humor retained, a similar operation is performed on the opposite side of the cornea. This operation should, I think, be limited to those extreme cases of conical deformity which cannot be palliated by any optical contrivance.

Slight cases are sometimes benefited by deeply concave glasses ; but in the complete stage of the disease, the sight is little, if at all, aided by glasses of any kind. A small aperture, like a pin-hole, in a metallic plate, held close to the eye, will in most cases of confirmed conical deformity enable a patient to read at a focus of five or six inches, who previously had

been unable to discern a letter. If, instead of a hole, a slit, about three-quarters of an inch long and the thirtieth of an inch wide, be made in a metallic plate fixed into a spectacle-frame, a considerable extent of lateral vision is obtained, without any necessity for moving the head in the way which is necessary when objects are viewed merely through a small circular aperture. It was the benefit derived from this slit in a metallic diaphragm which suggested the operation of iridodesis, just described.

[The defective vision in conical cornea is due chiefly to irregular astigmatism, which is not correctable with glasses; but there is usually, also, more or less regular astigmatism, by the careful correction of which vision may sometimes be greatly improved. No operative treatment of this affection is altogether satisfactory, though several operations have been recommended by high authorities. The safest is an iridectomy performed with the view of diminishing intra-ocular tension, and, at the same time, extending the pupil to the less distorted part of the cornea. Græfe formed an eschar by removing a superficial piece from the apex of the cone with a narrow knife, and applying the "mitigated stick" of nitrate of silver to the exposed surface. The use of the actual cautery, by means of a small, probe-pointed iron or the end of a strabismus hook, has been recommended. Bader excises a small elliptical flap from the apex of the cone.]

Quite ineffectual have been the lotions, the drops, the escharotics, which have been used in every possible variety. Their employment was justified by the expectation that local astringents might induce contraction in the tissue of the cornea; and if they failed to do this, they at least, if carefully used, could do no harm to the patient's system. But a plan of treatment was devised some years ago, which appears to be so utterly irrational, and is so fraught with mischief to the digestion and general health of the patient, that I cannot quit the present subject without a few words of warning against it. The plan consists in giving the patient a grain of tartar-emetic, or a scruple of sulphate of zinc, together with two, three, or four drachms of sulphate of magnesia, every day for a year, or even longer. How any patients could be found willing to submit to such treatment is perfectly astonishing. I have, however, seen several who had done so. One poor woman had punctually followed out this "emeto-purgative plan" for one whole year, and for nine years longer had taken the mixture at intervals. She was a martyr to dyspepsia, as might well be imagined, and utterly broken down in general health. Her corneæ remained conical.

Arcus Senilis.

This term is by no means well chosen, for the change in cornea which it implies commences long before old age can be said to have arrived, and by the time the patient has reached the age of sixty or seventy the arc has usually been converted into a complete circle. Several years ago, Canton described the appearance as being due to a fatty degeneration of the peripheral portion of the cornea; and the term "arcus adiposus" would therefore be well applied to its early stage, and "annulus adiposus" to that condition in which the white ring completely encircles the cornea. In many persons past forty years of age, in some even at a much earlier period, an opaque whitish crescent may be observed skirting the margin of the cornea, either at its upper or lower part. This opaque crescent is the commencement of the so-called "arcus senilis;" and on close inspection it will be seen that the opacity is not an extension of the white tissue of the sclerotic into that of the cornea, but that a narrow interval of partially clear cornea always intervenes between the two opaque structures. In some old persons, the circle assumes a chalky whiteness, and presents a very striking appearance.

"Arcus senilis" is considered by some observers to indicate the coexistence of fatty degeneration of the heart. As far as the eye itself is concerned, the change can be considered as of very little importance. It certainly does not, as has been asserted, in any way contra-indicate the operation of cataract by extraction; for I have many times carried my section through a strongly-marked "arcus senilis," and the wound has become quickly and firmly united.

Inflammation of the Cornea.

(*Keratitis; Corneitis.* The former of these terms—from κερατιτης, horny—is undoubtedly preferable to *Corneitis*, which is neither Greek nor Latin.)

The healthy cornea, as I have already observed, is of the most perfect transparency, and its surface smooth and brilliant in the highest degree. These qualities are lost as soon as the part becomes inflamed; a general haziness overspreads the whole structure, and the surface looks like a steamy glass.

If the inflammation be acute, a crescentic plexus of vessels will be seen passing from the edge of the cornea for some

little distance—a line or more—into its substance. These vessels are so fine, and so closely set together, that they produce the appearance of a small patch of blood smeared upon the surface of the cornea. With a lens of an inch focus, the individual vessels composing the plexus may be identified. The characteristic plexus sometimes involves a third or even a half of the corneal circumference.

A zone of pink vessels is always seen in the sclerotic adjacent to the cornea, whenever any form of active keratitis is present; this *sclerotic zone* also exists whenever the iris is inflamed. It is therefore always to be regarded as an important sign. As acute keratitis advances, some portion of the hazy cornea may become more decidedly opaque, and of a pale-yellow tint; this shows that softening is going on, which may lead to actual giving way of the part. Intolerance of light and abundant secretion of tears accompany keratitis. The larger venous trunks of the conjunctiva become full and distended, but there is an absence of that fine vascular network in the conjunctiva which characterizes ophthalmia.

One eye is usually attacked at a time, but the other may sooner or later become involved, and it very often happens that the second eye becomes inflamed just as the first is recovering.

Children and young persons are the most frequent subjects of keratitis, and the disease is rare after the age of twenty. The subjects of it are usually of a weakly, irritable constitution, often pale and anæmic; in some cases presenting the swollen cervical glands and other marks of scrofula.

The prognosis is favorable in proportion as the patient is young, and is seen at an early stage of the disease.

The mischievous and too common practice of keeping such patients confined to darkened rooms often induces a morbid irritability of the nervous system, and an intolerance of light, which is still farther aggravated by the irritating drops so unsparingly applied to eyes affected with corneal inflammation.

Under judicious management a case of keratitis occurring in a child may sometimes pass off without leaving a trace of opacity. But when the disease occurs after puberty, and is severe and obstinate, perfect transparency is hardly ever restored, and the cornea remains ever afterwards rather more convex than natural, and very faintly mottled with opacities and partially transparent interstices. These opacities resulting from long-continued keratitis, without ulceration, require to be thoroughly understood; for the surgeon who has not made himself familiar with their appearance will be sure to overrate the patient's powers of sight. It seems as if long-continued keratitis in patients who have passed childhood were attended with some peculiar change in the fibres of the cornea, whereby those portions which present only the slightest traces of opacity become, from irregular refraction of the rays of light, unable to transmit a clear and well-defined image of objects.

Treatment.—I have already alluded to the constitutional peculiarities commonly met with in patients who are the subjects of keratitis. They are in every way unfitted to endure the "antiphlogistic" measures recommended in so many works on eye-diseases. The diet should be nutritious and abundant, but not given in such quantities as to oppress the stomach and impair digestion. Very young children are almost always better without beer or wine. The former should be given to older children once a day if they have been accustomed to it; but wine can only be required by children suffering from extreme debility; in ordinary cases it hurries the circulation, and increases the general irritability of the nervous system. Of course the condition of the bowels is to be carefully attended to; and where the state of the biliary and other secretions may demand the use of mercury, an occasional dose of calomel—one or two grains, with or without a proportionate quantity of rhubarb—is to be given; but anything like a mercurial course is to be avoided. Iron is, of all substances, the most beneficial in cases of genuine keratitis, but it frequently fails in consequence of being given in too large doses, and for too long a time without any pause. The tinctura ferri sesquichloridi is the form I usually prefer, giving it invariably directly after food, or even during a meal, and in doses varying, according to age, from five to twelve drops twice a day. The syrupus ferri iodidi is sometimes useful. Occasionally, when the patient is feeble, ill-nourished, or of phthisical tendency, cod-liver oil may be given as well as the iron, or even, for a time, instead of it.

Counter-irritation, by means of small blisters to the temples, is often valuable in combating the intolerance of light; and tincture of iodine, applied to the skin of the lids, also conduces to the same end, and is preferable to blisters in patients of extreme delicacy of constitution.

Inflammation of the cornea is essentially a tedious disease, and the surgeon must often wait patiently for weeks, and even months, before the transparency of the part is restored. Hence it will be seen how necessary it is to give the tonic medicines in small doses, such as the patient can go on with for a considerable period, instead of attempting to conquer the dis-

ease at once by giving large doses, which cannot be persevered in without derangement to the stomach and liver.

Warm fomentations, night and morning, or steaming the eyes over hot water, will usually be found to allay their irritability; but all stimulating lotions and drops do harm. [The most grateful and useful application is atropia.]

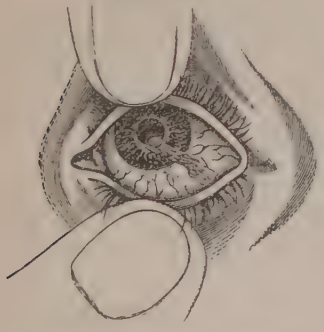
How any one who has seen much ophthalmic practice can recommend the application of solid nitrate of silver to the conjunctiva in cases of keratitis, I cannot comprehend. The same substance in solution, and the sulphates of copper and zinc, are also frequently employed, and sometimes the ointments of the nitrate and nitrico-oxide of mercury are added, as if on purpose to increase the irritation already existing.

"Scrofulous or Strumous Ophthalmia" (so called). [Phlyctenular Keratitis.]

At page 53 I have observed that the well-known disease commonly called Scrofulous Ophthalmia (*Phlyctænular Ophthalmia* of Mackenzie) derives all its importance from the fact that the cornea is implicated; and I therefore proposed to separate the disease from the group of conjunctival inflammations, to which alone the term "Ophthalmia" strictly belongs, and to treat of it under the head of Inflammation of the Cornea.

It specially attacks children, but certainly is not always confined to those of scrofulous constitution; at least it is met with where there is no evidence of tubercular disease. The most striking symptom is extreme intolerance of light (*photophobia*), and general irritability of the eyes and of the whole system. The local affection of the cornea shows itself either in a small whitish elevation (*phlyctænula*), or an ulcer. In either case a long plexus of vessels runs from the corneal margin to the morbid spot. This long plexus or lash of vessels is quite diagnostic of the disease [Fig. 257]. It is sometimes seen when the rest of the cornea is almost clear, but more commonly there are several phlyctænulæ or ulcers, and the whole of the cornea is more or less hazy. The intolerance of light I have mentioned, as being characteristic of the disease, causes violent spasm of the orbicularis palpebrarum, which is increased when the surgeon makes any attempt to examine the eyes. The intolerance is often much increased by the too common but most injudicious practice of keeping the patients in dark rooms. After many hours of darkness, the sudden admission of light is of course extremely painful. If the intolerance is very great, or the child too young to be open to persuasion, the examination must be made by means of the wire speculum. [The examination, in such cases, may be made much easier for both patient and surgeon by etherization.]

[Fig. 257.



Phlyctænular keratitis (Jones).]

The pain caused by exposure to light is often out of all proportion to the extent of corneal disease. In some extreme cases the surgeon is surprised to find merely a small whitish elevation (*phlyctænula*), or an ulcer the size of a pin's head, with the characteristic streak of vessels reaching to it from the edge of an almost clear cornea.

In true cases of this form of keratitis there is hardly any increase in the mucous secretion from the conjunctiva, but the flow of tears is profuse, and they gush out each time the lids are separated. There is a more or less marked zone of vessels in the sclerotic immediately around the cornea, but no general redness of the globe, the chief increase of vascularity being due to distension of the larger veins of the conjunctiva. The lids are often raw and excoriated at the edges, and the outer commissure is inclined to crack and bleed. Swollen and fissured lips and alæ nasi, excoriations and cracks behind the ears, eczema on various parts of the face, and eruptions on the scalp, are occasionally found to accompany this disease of the eyes in the more severe and long-continued cases.

Treatment.—Both the skill and patience of the surgeon are often severely tried by these cases, especially if they have been neglected, or treated injudiciously, before coming into his hands. Long-continued doses of mercury, seclusion in dark rooms involving the loss of air and exercise, and too much of food and stimulants, are the common sources of unsuccess as regards general management, whilst the local application is too often just that which is most hurtful—namely, nitrate of silver.

Under the head of Catarrhal Ophthalmia I have spoken of the valuable prop-

erties of this substance in solution, in cases where the inflammation is limited to the conjunctiva; and I have also mentioned how beneficially the application of the solid nitrate acts in arresting the rapid ulceration of the cornea in purulent or gonorrhœal ophthalmia. But the too common practice of dropping in a solution of the nitrate in cases where the cornea is attacked either with phlyctænulæ or ulcers, is most mischievous, and often prevents the cure of a case which in other respects may have been judiciously treated.

I have said that children attacked with this disease should by no means be shut up in dark rooms. Light is as essential to the health of animals as of plants, and all inconvenience from bright light can be averted by the use of a large shade, or in elder children by a pair of tinted spectacles. Out of doors a blue or green veil may be added. Moderate exercise in the open air should be taken whenever the weather is mild and dry, and sea-air is generally the most desirable, provided the place selected be not too bleak and windy. I have alluded to the ill effects of too much food and stimulants; but in doing so, I would not be supposed to recommend low diet: on the contrary, there should be an abundance of nutritious, easily-digested food. My remark was directed against that pernicious practice of stuffing young children with more animal food than the stomach can properly digest, and over-exciting their irritable circulation with wine and beer, as if their disease could, as it were, be taken by storm and extinguished by mere eating and drinking. Of course there are exceptional instances of very weakly children who require a small quantity of wine; but, as a rule, beer is preferable at an early age, and to those unaccustomed to stimulants pure milk will often be found of far more service.

With respect to drugs, I know of nothing so useful as iron in cases of keratitis, whether attended with phlyctænulæ or ulcers. It may be given alone, or in combination with quinine, according to circumstances. The reason why iron is so often ineffectually prescribed in this disease and in many others, appears to me to be, that it is given in too large doses and at wrong times. The form I prefer is the tinctura ferri sesquichloridi, in doses of 5, 10, or 12 drops, twice or thrice a day, to children ranging from five to fifteen years of age. It is best taken in water, and always immediately after a meal. Weakly children may at the same time take with advantage cod-liver oil. Every fortnight or so the iron may be discontinued for a couple of days, and if the bowels have become confined, or the liver appear to be deranged, a mild aperient may then be taken, with half a grain, a grain, or two grains of calomel, according to age and constitution.

Of local applications none are so generally employed as blisters; and no doubt, when used judiciously, they are very serviceable in subduing that intolerance of light which is one of the most distressing features of the disease. But here again a great mistake is frequently made in applying blisters of too large a size, and without sufficiently discriminating between those constitutions that will and those that will not bear them.

In feeble anæmic subjects a blister, even of small size, will often produce considerable depression; and in very young children with irritable skin, will bring out a troublesome eczematous eruption. The best effect is produced by applying blisters the size of a shilling or a florin to the temple, allowing the part to heal quickly, and repeating the blister when the cuticle is reproduced at the end of a week or ten days. A more rapid form of counter-irritation is that produced by undiluted tincture of iodine, painted on the skin of the upper lid. This may be repeated as often as the skin recovers its natural condition.

The lids may be bathed night and morning with warm water, or the steam of hot water may be allowed to play against them, which avoids the mechanical irritation of rags or sponges.

Spermaceti-ointment, or fresh olive-oil, may be smeared along the eyelashes at bedtime. Lotions of acetate of lead, or alum, two or three grains to the ounce of water, are sometimes useful where there is on the cornea merely a small opaque patch (phlyctæna), with the characteristic lash of vessels running to it; but whenever an ulcer exists lead-lotions are improper, as the carbonate of lead, which is precipitated from them, is liable to form an insoluble white deposit in the cicatrix.

Leeches always do harm in cases of true keratitis with ulceration of the cornea. The barbarous proceeding termed "scarification of the lids," is, I hope, so nearly obsolete as not to require notice.

To get rid of the plexus of vessels running from the edge of the cornea to the phlyctænula or ulcer on its surface, it has been gravely proposed that the vessels should be cut across with a lancet. This is, indeed, beginning at the wrong end. "*Ubi stimulus, ibi affluxus;*" so long as an irritable patch of deposit, or an ulcer exists, so long will an irregular supply of blood be sent thither. Heal the ulcer, or get rid of the irritability of the cornea, by constitutional means, and the plexus of vessels will vanish.

The opacities remaining after a long-continued attack of scrofulous ophthalmia are, to a certain extent, permanent; that

is to say, if they result from the healing of ulcers. But if the ulcer be superficial and the child very young, it is surprising to see how faint a trace remains in after-life, to mark the site of the cicatrix.

[The treatment of this form of phlyctenular ophthalmia is much the same as that of phlyctenular conjunctivitis. (See page 52.) Astringents are not usually well borne, and reliance is to be placed chiefly upon atropia and calomel powder.]

Syphilitic Keratitis.

It is to the careful observations of Hutchinson, that we owe the true knowledge of this remarkable form of corneal inflammation. Not that he detected a disease which had never been seen before; on the contrary, it was in patients who might have been selected as affording typical specimens of "strumous ophthalmia" that he first declared the morbid appearances to be due, not to scrofula, but to inherited syphilis. He named the disease "chronic interstitial keratitis;" but I think we may fairly substitute the shorter term *syphilitic*. No confusion can arise from thus naming the disease, because there is no special form of corneal inflammation connected with acquired syphilis, the chronic interstitial form being met with exclusively as a sequela of an *inherited* taint.

The subjects of this form of keratitis are children and young persons from five to eighteen years of age, and most frequently it is an eldest child that comes under observation. The disease begins at the centre of one cornea, in the form of a diffused haziness, like that of ground glass. Very soon whitish dots appear in the midst of the haze, not on the surface, but in the very substance of the cornea. These dots generally run together, and thus increase the amount of central opacity. At first there is but little attendant vascularity of the sclerotic and conjunctiva, but as the central opacity becomes more marked, these tissues become reddened, and a fine plexus of vessels spreads on the cornea itself, and gradually pervades the opaque portion, affecting the upper and central part of the cornea in preference to its lower half. Throughout the whole course of the disease there is no tendency to ulceration.

Usually within about two months—or it may be much earlier—the other cornea begins to be affected, the disease commencing, as in the eye first attacked, by a central haziness.

The vascularity of the cornea, when the disease is at its height, is wholly unlike that which attends granular lids, and other chronic forms of keratitis. In the latter the vessels are large and superficial, whereas in the disease now under consideration they penetrate the cornea so deeply, and are so fine and closely set together, that the effect produced is that of a tissue infiltrated with blood.

"In almost all cases the subjects of this keratitis," says Hutchinson, "present a very peculiar physiognomy, of which the most striking signs are, a coarse flabby skin, pits and scars on the face and forehead, cicatrices of old fissures at the angles of the mouth, sunken bridge to the nose, and a set of permanent teeth peculiar for their smallness, bad color, and vertically notched edges." He adds: "As diagnostic of hereditary syphilis, various peculiarities are often presented by the other teeth, especially the canines, but the upper central incisors are the *test-teeth*. When first cut, these teeth are usually short, and the cutting edge is narrow from side to side, and very thin. After a while a crescentic portion from their edge breaks away, leaving a broad, shallow, vertical notch, which is permanent for some years, but between twenty and thirty usually becomes obliterated by the premature wearing down of the tooth." . . . . . "I have not met with a single example of well-characterized interstitial keratitis in which the teeth were of normal size and shape."

More extensive experience has caused Mr. Hutchinson to modify this last remark, and he mentions several exceptional cases in which all the appearances of syphilitic keratitis were present, in association with well-formed teeth.

One very remarkable instance of keratitis—I think the severest I ever saw—occurred in my own practice, in a young lady whose teeth were quite remarkable for soundness and symmetry; but in her the peculiar physiognomy was well marked, and her history completely confirmed the fact of her inherited syphilis. I have also seen some striking cases, in which patients with well-formed features, and clear and ruddy complexions, had strongly-marked syphilitic keratitis; but their teeth were more or less affected. We may therefore meet with severe syphilitic keratitis in patients with healthy physiognomy and deformed teeth; or—still more rarely—in those with faultless teeth and the syphilitic cast of features; but to find the true form of keratitis in connection with both good teeth and good complexion also, is, I think, next to impossible.

I frequently notice that medical men who have not read Hutchinson's careful descriptions, but have only heard of "notched teeth," expect to find serrated edges, such as one so often sees in newly-cut healthy incisors. "Serrated," how-

ever, implies a series of notches. A single notch is that to which Hutchinson first drew attention, and the following figure, copied from his work, will at once show the reader what he is to look for.

Fig. 258.

Teeth in inherited syphilis.

In adults the notch often becomes worn away, but even then the tooth retains a characteristic shape. I liken it to that of a screw-driver, being wide at the base, where it joins the gum, and narrow at its cutting edge; while its lateral edges are thick and rounded. The lower incisors never lose their peculiar form, which is more or less cylindrical, and they are commonly wider apart than healthy teeth.

It must be always borne in mind that these syphilitic peculiarities in the teeth are only met with in the permanent set. The first set are not notched, but they are usually stunted and prone to premature decay.

Treatment.—A combined specific and tonic plan is advocated by Hutchinson, as being more efficacious than one exclusively tonic, and he advises the cautious use of mercurials and iodides. He prefers to administer the mercury by rubbing in the milder ointment, always avoiding ptyalism, and gives internally iodide of potassium and iodide of iron.

I believe iron, under some form or other, to be the one drug needful. It should be given in small doses, because the cure is necessarily very slow, and the medicine must therefore be continued for many months. An occasional small dose of calomel—a grain or so once a fortnight—is requisite to prevent the iron deranging the liver, but I do not think "a mercurial course," as it is termed, necessary or beneficial. The forms of iron I prefer are the tincture ferri sesquichloridi, and syrup. ferri iodidi. For a young child six or seven years of age, eight or ten drops of the tincture, given once a day immediately after a meal, will be a full dose; each fortnight it may be left off for a day or two, and a grain of calomel given. Even for patients sixteen or eighteen years old, the dose of the tincture need never exceed fifteen or twenty drops.

Good diet, pure air, and all things calculated to improve the condition of the blood and tissues, are of the utmost importance in treating the cachectic subjects of inherited syphilis. The surgeon must ever bear in mind that the severer forms of syphilitic keratitis require a very long time for their cure. A bad case will require a year or even longer, and the friends of the patient ought at the very first to clearly understand this. A rapid cure is quite impossible. If only the vascularity of the cornea disappears, and from month to month the part becomes less opaque, the very worst case may terminate satisfactorily. It is, however, unreasonable to expect that in very severe cases absolute transparency of the cornea will ever be attained.

[The most useful remedies are iodide of potash, iodide of iron, and cod-liver oil. Bichloride of mercury may sometimes be given with advantage in very small doses, not too long continued. Dusting calomel on the cornea occasionally is thought by some surgeons to hasten the disappearance of the opacity. The objection to the use of calomel in this way when iodide of potash is being administered internally, on the ground that it is converted into iodide of mercury by the iodine in the tears, is more theoretical than practical.]

A very chronic kind of iritis commonly accompanies the severer forms of syphilitic keratitis, and the consequent deposits in the pupil, or around its margin, are first detected when the cornea is recovering its transparency.

Keratitis with Suppuration.

In simple inflammation of the cornea, the opacity, however dense it may be, consists of inflammatory exudation among the fibres of the part, without any destruction of the fibres themselves. Under certain conditions of the patient's system, however, the inflammation may run a very acute and rapid course, and within a few days terminate in suppuration or ulceration.

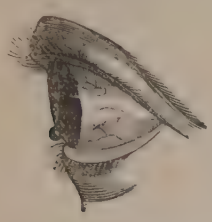
When suppuration takes place in the substance of the cornea, it is most frequently at the centre, or a little below that spot, that the pus collects. Its presence is usually manifested by a small yellowish patch in the midst of the general haziness. In very severe cases this yellow patch may rapidly spread until the whole cornea assumes one uniform creamy tint, entirely hiding every trace of iris; the cornea then softens, and gives way at some part, the iris prolapses, and vision is eventually lost.

These are extreme cases; a more ordinary form of suppuration is that in which the pus gradually infiltrates the lower third, or even the lower half, of the cornea, and at last makes its way through the posterior elastic lamina, and then

sinks down to the bottom of the anterior chamber, where it forms what is termed *hypopyon*.[1]

The giving way of the posterior elastic lamina of the cornea is sometimes speedily followed by that of the anterior lamina, and in that case a perforation is established, through which a prolapsus of the iris takes place.

[Fig. 259.



Prolapse of iris (Miller).]

This perforation of the cornea is followed by immediate relief of the severe pain which had existed as long as the pus was pent up among the fibres of the cornea, or in the anterior chamber. This pain is often severe to a degree quite incredible to those who have never witnessed such cases, assuming the form of neuralgia, and wholly preventing sleep.

Treatment.—In general surgery we are so accustomed, whenever an abscess forms, to regard its evacuation as the very first indication for treatment, that I may be expected to mention a puncture for giving exit to the pus, as the most important step in treating a case of suppuration in the cornea. But although it is common to speak of *abscess* in this part, the matter is not contained in a distinct cavity, but is infiltrated among the corneal fibres, so that if an incision be made, the pus does not flow out. The cornea, too, differs from every other superficial tissue of the body, in being transparent; and we should avoid inflicting any unnecessary wound, even to the smallest extent, upon a structure, the transparency of which is essential to sight.

[When a deep ulcer is about to penetrate the cornea, a prolapse of the iris may often be prevented by evacuating the aqueous humor carefully by means of a paracentesis, the scar of which, if perceptible at all, is much less than that resulting from a spontaneous rupture. In sloughing keratitis with hypopyon, and particularly in the circular form of spreading slough ("ulcus serpens"), which is usually the result of an injury, the treatment recommended by Saemisch is now generally adopted, and offers the only chance of success in cases that have refused to yield to tonics, stimulants, and anodynes, the compress bandage, and hot stupes. A free incision is made through the base of the ulcer with a narrow Graefe cataract knife, commencing and ending in the sound corneal tissue on either side. The incision should be made very slowly, and, before it is completed, the knife blade should be slightly turned on its axis to allow the aqueous humor to escape gradually. A compress bandage is applied immediately. If necessary, the incision may be reopened daily for a few days, by means of a small probe, or the point of a Weber canaliculus knife.

The most important local remedy is the hot stupe. Fomentations of poppy, or chamomile, or simple water, of about 100° F., or as hot as the patient can bear without discomfort, are applied three or four times a day for half an hour at a time, being changed at least every five minutes during that time. Atropia is generally used, though eserine has recently been recommended by some authorities.]

The general tonic plan of treatment I have sketched out as suitable to cases of common keratitis will be applicable, with certain modifications, to keratitis with suppuration. We must take care not to reduce the patient's vital powers; for if we do, not only will the softening of the corneal tissue be likely to spread, but if perforation of the cornea takes place, there will be a deficiency of reparative material to fill up the breach, and a large prolapsus iridis, with consequent distortion or obliteration of the pupillary opening, will be the result.

In the very early stage of suppuration, when a small yellowish patch in the midst of the hazy cornea is all that is seen to mark the beginning of suppuration, blistering to the temple sometimes aids in checking the formation of pus; but when a considerable portion of the cornea has become infiltrated, and severe neuralgia sets in, blistering only aggravates the pain. Narcotics must then be given; to children, a few drops of tincture of hyoscyamus at bedtime; to adults a fuller dose—℥ss or ℥j. In very severe cases of neuralgia in the fifth nerve, hyoscyamus will be found unavailing, and morphia must be resorted to, especially if the patient be accustomed to the use of opium. Sometimes a piece of lint steeped in chloroform liniment, and laid upon the temple and forehead, over the region of the lachrymal and supraorbital branches of the fifth nerve, is of great service in lulling the pain.

If the infiltration and softening of the cornea go on to perforation, the aqueous

[1] This collection of pus at the bottom of the anterior chamber is by some authors termed *onyx;* others use the latter word—now almost obsolete—to signify an abscess in the substance of the cornea.

humor at once drains away, and then the neuralgia usually ceases, or is mitigated in a remarkable degree. If the pain ceases, so as to allow the patient to obtain sleep without the aid of narcotics, they ought, as soon as possible, to be laid aside; for they almost invariably take away appetite, and the patient is now in need of good nourishment to hasten the repair of the breach in the cornea.

Bark and ammonia, or quinine, may be required at this stage of the disease; but a carefully-regulated nutritious diet, with a moderate amount of stimulants, must be the chief sources of the reparative process.

As respects local treatment, protection from light, and occasional fomentation with warm water or poppy-decoction, comprise all that is necessary during the earlier stage. When, however, the cornea has given way, the eyelids must be kept constantly closed, either by the application of a strip or two of plaster, or by means of a light pad of cotton-wool, arranged around the eyeball, and kept in its place by a bandage. The eye should only be opened occasionally by the surgeon, to ascertain the progress of repair. In some cases it is useful to abstain from examining the eye for four-and-twenty or eight-and-forty hours.

When prolapsus iridis has occurred, this occlusion of the eye is especially useful, as, by keeping the parts at rest, an opportunity is afforded for the adhesion of the protruded iris to the edges of the aperture in the cornea. As soon as this adhesion has taken place, no more iris can escape, and the prolapsed portion gradually shrinks, and flattens down to the level of the cicatrix. When, from want of vigor in the patient, the adhesive process is sluggish, it is sometimes useful lightly to touch the prolapsus with a point of nitrate of silver.

To attempt to return a portion of iris which has prolapsed through a loss of substance in the cornea, is utterly futile; for it will protrude again and again, so long as there exists an aperture for it to escape through.

[The usual practice is to cut off the prolapsed portion of the iris close to the surface of the cornea, and apply a compress bandage to the closed lids.]

Disease of the fifth nerve, caused either by pressure on its trunk, as it is emerging by the side of the pons Varolii, or by primary degeneration in the tissue of the nerve itself, will give rise to a form of keratitis with suppuration very similar to that described in the preceding pages. In the cases of disease of the fifth nerve which I have seen, this affection of the cornea has not come on during the neuralgic stage, but at a later period, when, in consequence of partial or total destruction of the trunk of the nerve, there has been anæsthesia of the parts supplied by the ophthalmic division. In three or four cases which I have watched, the whole cornea was not destroyed; but after perforation had occurred, the process of softening ceased, and reparation so far took place that eventually there remained only an opaque cicatrix in the cornea, to which a portion of the iris adhered.[1]

"Exanthematous Ophthalmia" (so called).

(*Post-febrile ulceration of the cornea; Ophthalmia morbillosa; Ophthalmia scarlatinosa; Ophthalmia variolosa; Ophthalmia erysipelatosa.*)

The various forms of ophthalmia accompanying the exanthemata have been described by some authors with considerable minuteness; but if we restrict the term ophthalmia to signify an inflammation of the conjunctiva, it is perhaps in measles only that any very marked ophthalmia can be said to occur. Taking place, as it does, at the onset of the attack, it is one of the most marked symptoms of the disease, but demands no special treatment. The really important affection connected with measles, is the *ulceration of the cornea*, which results from the general debility produced by the disease. This ulceration is commonly attributable to a neglect of tonic treatment after the inflammatory symptoms have passed away. Iron and quinine, alone or in combination, cod-liver oil, the various influences of fresh air and nutritious diet, are all to be put in requisition to avert or to heal these ulcerations.

Scarlatina, on account of the greater exhaustion of the powers of life which it induces, is still more likely than measles to be followed by ulcers of the cornea. In some extreme cases of this frightful disease, the corneæ lose their vitality, and entirely slough away. The same system of tonics and nutritious diet which I have

[1] In a paper published in the eighteenth volume of the Medico-Chirurgical Transactions, 1845, I drew attention to the fact that anæsthesia of the fifth nerve was far more frequent on the *left* than on the right side. In 1857 I forwarded to the editors of the French translation of Mackenzie's Treatise (vol. ii., p. 763) a note containing all the literary references to cases of anæsthesia of the fifth nerve which I had collected up to that time. The result of the analysis of fifty-one cases is as follows: In five patients the fifth nerve was affected on both sides; in thirteen the right nerve only was affected; while thirty-three patients had anæsthesia of the *left* nerve.

mentioned as useful in averting the sequelæ of measles, would be still more urgently called for after an attack of scarlatina.

During erysipelas of the head and face, in the severe form, the lids are so completely closed by the swelling of the skin, as to hide the eyes from observation. In the stage of debility succeeding the attack, ulceration of the cornea may arise, as in the two diseases above mentioned; or the cornea may even slough, as in scarlatina.

Of all the exanthemata, smallpox produces the greatest damage to the eyes; and a large proportion of those persons whom we see with shrunken globes, or with their corneæ converted into chalk-like cicatrices, have lost their sight from the ulceration induced by this disease. It was formerly supposed that these opacities were produced by pustules on the cornea itself; but it has been ascertained that pustules never form on this part, the opacities being invariably the result of ulcers, caused by the extreme prostration which succeeds the inflammatory stage.[1]

Ulcers of the Cornea.

Under the various heads of *Purulent*, "*Scrofulous*," and "*Exanthematous Ophthalmia*," and in the section on *Keratitis*, I have mentioned the more formidable kinds of ulceration to which the cornea is liable. The cases, however, are very numerous in which corneal ulcers are developed in a more isolated manner than in any of the above mentioned diseases, being unattended either with purulent discharge from the conjunctiva, or general inflammation of the whole cornea.

Persons of all ages are liable to corneal ulceration. It is essentially a disease of debility, attacking those whose general power has been lowered by some exhausting illness, by bad or insufficient food, or some other depressing agency.

In persons of feeble reparative power, an ulcer, instead of healing up to the level of the healthy cornea, sometimes forms a slightly-depressed cicatrix. It is of course most important not to confound these two conditions, as is often done by those unaccustomed to the observation of eye-diseases. A recent ulcer, in which the destructive process is still going on, presents a sharply-cut, well-defined edge, with little, if any surrounding opacity, and the excavation itself, as regards transparency, offers but little contrast to the sound cornea. An ulcer which is healing is always more or less opaque throughout, and there is a cloudy halo surrounding it; and if the ulcer be large, vessels will be seen running to it from the edge of the cornea. A depressed cicatrix, on the contrary, has its edges smoothly rounded off, and its area is slightly opaque; there is little, if any, cloudy halo surrounding it, and seldom any plexus of vessels going to it from the corneal margin. In some cases, however, a depressed cicatrix is supplied by a small vessel or two, the remains of the plexus which once carried the material necessary for the healing of the ulcer which preceded it.

If the progress of an ulcer be not arrested, it may eventually perforate the whole thickness of the cornea. The aqueous humor then escapes, the iris falls forward, so that the anterior chamber becomes altogether obliterated, a portion of iris—large or small, according to the size or the perforation—protrudes through the opening, towards which also the pupil is displaced. If the prolapsus iridis be very large, the whole area of the pupil may be annihilated.

In rare cases the ulceration stops short at the posterior elastic lamina of the cornea, which, in consequence of the pressure from behind, is thrust forwards as an almost transparent vesicle, filling up the cavity of the ulcer. The term *hernia corneæ* has been applied to this protrusion. It would at once be distinguished from a *prolapsus iridis* by the retention of the aqueous humor, and the consequent persistence of the anterior chamber.

There is one remarkable form of corneal ulceration—which I have seen only two or three times—of a singularly destructive and intractable character. In all of the cases the patients were men who appeared by no means debilitated, as far as their general health was concerned. One eye only was attacked; the ulceration, commencing at the edge of the cornea, rapidly formed a deep crescentic groove, which continued to deepen and extend itself, until it had completely isolated the central portion of the cornea, which was left standing up in high relief. This central portion eventually yielded to the ulcerative process, and sight was of course entirely lost. It was remarkable that in all the cases the posterior lamina of the cornea either remained unbroken, or was perforated to only a small extent. The form of ulceration was very similar to that accompanying gonorrhœal ophthalmia; but there was no trace of purulent

[1] For this important fact we are indebted to the extended observations of Mr. Marson, at the Smallpox Hospital. He has lately published the results of his vast experience up to the present time. Among 15,000 cases of smallpox, he has seen twenty-six instances of pustules on the eyeball; but they have invariably appeared on the conjunctiva, never on the cornea.

discharge. There was very little pain or uneasiness, and the amount of redness in the conjunctiva and sclerotic was but trifling. Probably some change in the tissue of the vessels supplying the globe was the cause of this rapid and uncontrollable ulceration.

Treatment.—I have said that corneal ulcers are almost always a result of general debility, and therefore their cure is to be sought rather by improving the general power of the patient than by local applications. The exception to this rule is formed by those cases in which the ulcer is very large, exhibiting a total want of reparative action, and by those cases terminating in prolapse of the iris. In both of these instances, the local use of the solid nitrate of silver is often a very serviceable adjunct to the general treatment. [Most surgeons do not use the solid nitrate in corneal ulcers so freely as is recommended by the author. The "mitigated stick" is sometimes applied.]

The mischievous effects of lead lotions, when applied to ulcers of the cornea, have been already alluded to (p. 52); and solutions of nitrate of silver, if used for too long a time, will also give rise to insoluble deposits, and consequent opacities.

While everything tending to improve the general health is to be resorted to in cases of ulceration, the occasional use of warm water to the eyes is commonly the best local application. The eye should be kept lightly covered; and if there be intolerance of light, or much pain in the eye, complete closure of the lids is indicated. This closure is especially necessary when either the iris has prolapsed, or a hernia corneæ has taken place.

I have already (p. 74) said how useless must be the attempt to push back a portion of iris protruding through a corneal ulcer. If the little nodule of iris soon becomes coated with an opaque layer of adhesive deposit, simple closure of the lids, and support of the general power by suitable diet and tonics, will suffice to cause the protruded iris to become adherent to the edge of the ulcer; after which, no further prolapse will occur. But if the protruding iris, instead of becoming coated with lymph, retains its natural color and fibrous appearance, a touch with a fine point of nitrate of silver will often set up sufficient inflammation to cause adhesive deposits to take place [see p. 74]. In like manner the deep excavated ulcer, which sometimes forms in very anæmic and weakly persons, and threatens to perforate the cornea, or to destroy it by rapidly spreading all around its margin, may be arrested, and a healing disposition given to it, by lightly passing the solid nitrate over the whole excavation and edges of the ulcer.

Opacities of the Cornea.

It is of the utmost importance as respects both prognosis and treatment, that the surgeon should make himself perfectly familiar with the varied appearances which corneal opacities assume. Without this knowledge, he will be constantly liable to deceive both himself and his patient, in promising the removal of opacities which are in their very nature permanent; or in pronouncing incurable, hazy conditions of the cornea, which, if promptly and skilfully treated, may be perfectly removed. To the latter class belong those cloudy opacities which I have described (p. 67) as overspreading the cornea in the slighter forms of simple keratitis. The short period, a few days or weeks, during which the cloudiness had existed, the presence of a vascular zone in the sclerotic, and some degree of irritability of the eye, would all point out the cloudiness of the cornea as being due to simple inflammatory deposit within its substance, which, under suitable treatment, may be so entirely dispersed as to leave the cornea in all its original transparency. If, on the other hand, the same amount of general haziness were known to have existed for a long time—say a year or more—if there were a total absence of sclerotic redness, and if the eye had long ceased to be irritable, the surgeon would know that the opaque condition of the cornea was incurable, and he would no longer attempt the use of stimulating lotions and ointments, which could only arouse fresh irritation and increase the existing mischief.

The haziness which sometimes remains after a severe and obstinate attack of keratitis, presents an appearance not easy to describe, but which the experience of a few cases will readily enable the surgeon to recognize again. There is a total absence of unnatural vascularity about the eye, but the whole cornea is slightly shaded with a faint haziness, with intervening spaces of almost transparent tissue, through which the color and texture of the iris and the form of the pupil can be recognized, although not in their natural distinctness. The dimness of sight in these cases seems to be out of all proportion to the amount of opacity; and the patient can perhaps merely see black streaks when looking at a page of type.

[The indistinctness of vision is due in great part to irregular astigmatism, resulting from changes in the surface of the cornea.]

The terms *nebula*, *albugo*, and *leucoma* have been applied to corneal opacities, according to their different degrees of density; the slighter forms being distin-

guished as *nebulæ; albugo* and *leucoma* signifying rather the white opacity of cicatrices. The edge of a *nebula* is gradually shaded off into the surrounding clear tissue; that of a cicatrix, at least one of old standing, is more or less abruptly defined. Where a prolapse of the iris has taken place through a corneal ulcer, the leucoma which results is marked in the centre by a small blackish spot.

Treatment.—As regards the prognosis of nebulæ, their possible improvement mainly depends upon the age of the patient. In infancy, it is quite astonishing to see how the rapid interchange of material which is then going on, will diminish both the extent and the density of even large cicatrices. In an infant attacked with purulent ophthalmia, a cicatrix may at first be so large as to occupy the central third of the cornea, and yet, in after-life, a mere cloudy speck may remain opposite the centre of the pupil. At a later period of life, nebulæ, which form as the cicatrices of superficial ulcers, are more permanent; but around the denser part of the speck there is always a certain amount of cloudiness, which slowly disappears. The older the nebula, the more sharply defined is its margin.

Allusion has already been made to the permanent white deposit which occurs in corneal ulcers, when lotions containing lead have been employed. The metal is deposited in the state of carbonate, and forms a chalky-white layer on the ulcerated surface. Practice alone can enable the surgeon to recognize these old lead-deposits. They somewhat resemble a little patch of whitewash, their margin being sharply defined, and their surface often presenting minute cracks, through which the tissue of the cornea appears as dark lines. When the ulcer has been very superficial, and the metallic deposit lies just beneath the epithelium, the surgeon may sometimes succeed in scraping away the deposit; to do this, however, requires the utmost care and lightness of hand.

A very curious form of *calcareous deposit*—phosphate or carbonate of lime—between the cornea and its epithelium sometimes takes place without any previous inflammation. I believe this kind of deposit to be extremely rare, for, since I first noticed it in 1848,[1] I have seen only two other instances. From what I have already said concerning the nature of corneal opacities, the reader will perceive that when they are of old standing and unconnected with any existing inflammation, local treatment can avail but little. Setting aside those exceptional cases I have enumerated as removable by operation, the partial disappearance of old nebulæ is due to that change of material which is constantly going on in the human body, and which is so much more active in infancy and childhood than after the period of growth has terminated. The lotions, the drops, the vapors, the ointments, which crowd the pages of the older ophthalmic works, if not actually hurtful, as being likely to set up fresh irritation, are either altogether inert or at best they serve to amuse the patient while time is slowly clearing the opaque tissues.

[1] My case was first published in the Appendix to Bowman's Lectures on the Anatomy of the Eye, 1849; and a second time in my Guide to the Practical Study of Diseases of the Eye, 1855.

Injuries of the Cornea.

Abrasion.—The epithelium covering the anterior surface of the cornea is liable to be torn or scratched by coming in contact with any rough substance; or a little flap of the epithelium may be partially detached and doubled down. Those who have not seen these slight cases of injury to the epithelium cannot imagine how much pain they produce, especially in persons of a sensitive nervous system. A clean cut directly through the cornea often causes far less pain than an abrasion of the epithelium so minute as to be scarcely discernible.

Within a short time after the epithelium has been injured, the sclerotic is often much injected, and a profuse flow of tears follows every attempt to separate the lids. The surgeon will best obtain a view of the part by placing the patient in a chair and standing behind him. As soon as the lids are widely separated, the pain almost ceases, and the surgeon must then carefully explore the whole surface of the cornea, while the patient moves the eye in various directions, so as to allow a bright light to fall on each portion in succession. A slight irregularity and roughness at one minute spot is often all that can be found to mark the position of the injury.

The *treatment* of these abrasions is very simple. A drop or two of olive-oil or castor-oil may be applied to the abraded surface, and then the lids are to be kept closed with a light pad of cotton-wool, and a bandage for four-and-twenty hours. As soon as the epithelium is regenerated all irritation ceases, and the uniform polish of the cornea is restored.

Contusion of the cornea.—Blows on the cornea which do not cut or lacerate, but merely bruise, its tissue, vary greatly in their results, according to the violence of

the blow, and the age and vigor of the patient. In the severer forms of contusion, softening and suppuration among the fibres of the cornea will probably occur, and the part will afterwards exhibit more or less haziness. But in very feeble or old persons, the whole cornea may become softened and infiltrated with pus, and in such cases the pain is often very severe.

At length the cornea gives way, the aqueous humor escapes, and the pain immediately subsides; but the whole or the greater part of the cornea becomes pulpy and disintegrated, and comes away in shreds, and ultimately the globe shrinks, or else a staphyloma is formed. The worst cases of this kind occur among paupers engaged in stone-breaking. During such work, a pair of gauze-wire goggles should always be worn.

Treatment.—Even a slight contusion, if it takes effect at the centre of the cornea, must be regarded as a serious accident, on account of the suppuration and consequent haziness that may possibly ensue. We must take care, therefore, not to reduce the patient by bleeding and mercury, since by so doing the vitality of the cornea is lowered, and softening and suppuration are more likely to take place. An eye which has received a blow on the cornea should be kept closed and defended from light, and poppy fomentation may be used, if any pain comes on. If the case be seen early, a blister to the temple is sometimes useful as a counter-irritant. A narcotic may be required at bedtime; and the diet should not be reduced below that which is suited to the patient's ordinary condition.

The setting-in of suppuration, attended as it is with pain, would require an increased dose of the narcotic; and should the cornea give way, a tonic treatment, with a suitable proportion of stimulants, would become necessary, to limit the destruction of tissue, and afford material for repair. [See page 73.]

Incised and punctured wounds. — Although cuts of the cornea are usually produced by sharp-edged or pointed bodies, they also occasionally result from sudden blows inflicted with blunt ones; and a smart stroke with a stick will sometimes inflict on the cornea a cut as clean as if made with a knife. Wounds of this latter description, however, on account of the shock given to the whole eye, are usually much more serious than those made with sharp instruments. A wound involving one-half of the corneal margin, such for instance as is made in the operation of extraction, may become completely united within three or four days, without inflammation occurring in any other tissue of the eyeball, whilst a much smaller cut produced by a blow with a stick or stone will be followed by severe and long-continued inflammation, ending in complete disorganization of the globe. Small sharp bodies, such as fragments of metal or glass, when driven with great force and rapidity against the cornea, frequently produce so small a wound, that a surgeon unaccustomed to see such cases may be apt to underrate the size of the foreign body which has inflicted the injury; the elasticity of the corneal tissue causing the wound to contract as soon as the foreign body has passed through. When a case of this kind is seen immediately after the injury, the most careful scrutiny, with all the advantages of a good light, is often required to enable the surgeon to detect the wound. The whole surface of the iris, and especially the bottom of the anterior chamber, should be most carefully examined, in order to detect the lodgment of the penetrating body; and if the cornea be still transparent, and the aqueous humor retained, the pupil may be dilated with atropine, and the lens and deeper tissues explored with the ophthalmoscope. If any portion of the penetrating body protrude from the wound, it should be at once extracted with a fine well-closing forceps, the lids being held apart with a spring speculum, and the globe steadied by nipping up a fold of the conjunctiva covering the sclerotic.

When the wound of the cornea is large, a portion of the iris is frequently forced through the wound. If such a case is seen within a few hours of the accident, and before there has been time enough for the protruded iris to become united to the margins of the corneal wound by adhesive deposit, the portion of iris may sometimes be returned by careful pressure with a probe or small spatula. If, however, adhesion between the cornea and iris has already taken place, this reduction is impossible; and the surgeon must then content himself with maintaining the parts in perfect rest by keeping the lids closed; or if the protruding and strangulated iris be indisposed to shrink, it may be lightly touched with nitrate of silver, and the lids again kept closed for some hours [see p. 74].

Sometimes the protruded portion of iris gradually becomes distended with aqueous humor, and assumes a rounded pouch-like form. This little pouch should be freely punctured, or a portion of it cut off with curved scissors, and then the nitrate of silver and the bandage applied as before.

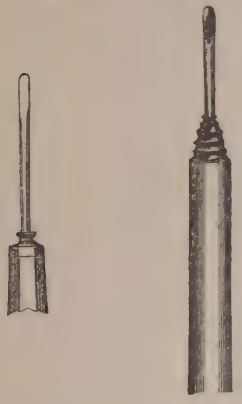
The advice I have here given, as to returning the iris protruding through an incised wound of the cornea, may at first

appear to be inconsistent with what I have before said, at page 74; but the difference between the two cases consists in this—that when an ulcer has perforated the cornea, there is an actual loss of its substance, and if the iris protruding through such an aperture be pushed back, it will escape again and again. But in the case of an incised wound there is no loss of corneal tissue, merely a separation of its fibres; and if the protruding iris be returned into the anterior chamber, the elasticity of the corneal tissue will bring the edges of the wound into apposition, and keep them so until they have become united.

Punctured wounds of the cornea vary much in their character, accordingly as they are inflicted by means of pointed bodies of a large size, or by such small fragments as remain embedded among the fibres of the part. Wounds of the former class frequently involve other parts of the eye, and penetrate through the cornea into the iris or the lens. These complicated injuries cause either iritis or cataract, and will be spoken of in future chapters.

The simplest and by far the most common form of puncture of the cornea is that which happens when little fragments of metal or grit are forcibly projected against the eye, and remain sticking either in the epithelium or in the superficial layer of the cornea itself. Engineers, metal-turners, mill-stone dressers, stokers, are constantly liable to these injuries; and the surgeon should be able at once to remove the foreign body without inflicting in the attempt any farther injury on the cornea. Standing behind the patient,

[Fig. 260. Fig. 261.



Spuds for extracting foreign bodies.]

who should be seated opposite a window, the surgeon raises the upper lid by placing the tips of his first and second fingers against the edge of the tarsus, beneath the cilia, and then pressing the lid upwards and backwards without everting it; he then with these two fingers steadies the globe by gentle pressure just above the cornea, while the point of the ring-finger gently presses the globe at its inner side. In the other hand he holds a little spatula-shaped instrument (which for want of a better name I have called a "spud"), the flat end of which he passes under the foreign body, and so tilts it out. The point of a cataract-needle or a lancet, on account of its fineness and delicacy, is very unsuitable for extracting these little bodies. All the treatment necessary after their removal consists in keeping the eye closed for a day or so, with perhaps occasional fomentation.

If an elongated chip of metal strike the eye obliquely, it sometimes wedges itself into the cornea at about the middle of its thickness, lying exposed to view, but so completely buried as to afford no hold to a forceps. The surgeon must with a cataract-knife or cutting-needle slit up the layer of corneal substance along the whole length of the foreign body, which can then be turned out without difficulty.

One of the injuries most difficult to treat is that inflicted by a sharp-pointed chip of metal just long enough to transfix the cornea, and to thrust its point into the anterior chamber, while the other extremity is so much embedded as to offer no hold for a forceps. If the surgeon attempts to dig out such a chip, he will almost certainly drive it farther in, until at last it slips wholly into the anterior chamber, and entangles itself among the fibres of the iris.

The removal of the foreign body will call for all the operator's skill and patience, and chloroform [or ether] must be used if the patient be timid and unsteady. The lids being separated with a spring speculum, an assistant fixes the globe by nipping up with a forceps a fold of the conjunctiva at its lower part. The surgeon then, with a broad cutting-needle, makes an opening in the cornea close to its outer margin. The needle should be slowly withdrawn, without rotating it in the slightest degree, so that the aqueous humor may, as far as possible, be retained. Then a small spatula is to be passed in at the opening, and carried quickly and steadily across the anterior chamber, so as to interpose between the lens and the intruding point of the foreign body. The spatula is then to be pressed forward against the foreign body to keep it fixed, while, with a cataract-knife or cutting-needle held in the other hand, the surgeon slightly enlarges the wound on the anterior surface of the cornea. Still steadying the point of the foreign body with the spatula in the anterior chamber, he en-

deavors with a very fine and well-closing forceps, to grasp the extremity of the foreign body and draw it out of the wound.

[If the foreign body is of iron or steel a magnet may sometimes be used with advantage. It has even been successfully used in the extraction of foreign bodies from the vitreous chamber.[1]]

I have had occasion several times to perform this operation, which the minuteness of the foreign body, its close proximity to the transparent lens, and the necessity for limiting the extension of the external wound, combine to render one of the most difficult in ophthalmic surgery.

A foreign body, which passes quite through the cornea, may wound the lens and remain embedded in its substance, producing a traumatic cataract; or it may become fixed in the iris; or, having lost its momentum in traversing the cornea, it may fall down to the bottom of the anterior chamber. Under any of these conditions, if the surgeon sees the case immediately after the accident, while the cornea is still clear, and the iris and anterior chamber are not yet obscured by inflammatory effusions, he should endeavor at once to extract the foreign body. If it can be distinctly seen sticking in the lens, it will be right to make a section of the upper half of the cornea, and remove the lens, as in the ordinary operation for cataract. A chip of metal, fixed in the iris, may be removed with Assalini's spring-forceps,[2] or the canula-forceps, introduced through a small corneal wound; and in the same manner foreign bodies of any kind, which are lying loose in the anterior chamber, may be seized and extracted.

The surgeon must not be deterred from attempting to remove these foreign bodies by the stories he will find in many of the older ophthalmic works, about the oxidation, and solution, or encysting of metallic fragments. The lymph which is thrown out around a metallic chip in the iris does indeed, for a time, encase it and hide it from view; but this is only the beginning of a tedious iritis, which will probably end in disorganization of the eye, or, at least, produce obstruction of the pupil and loss of sight.[3]

Foreign bodies lying loose in the anterior chamber are to be removed in a similar way to that I have just recommended in the case of bodies fixed in the iris; the extent of the corneal incision being of course proportioned to the bulk of the body to be extracted.

This may perhaps be the most convenient place to notice those rare cases in which a living entozoon constitutes the foreign body in the anterior chamber.

The *Cysticercus telæ cellulosæ* has been repeatedly met with in this situation, as a rounded, semi-transparent, vesicular body, furnished with a long retractile neck, terminating in a head furnished with suckers and a circlet of hooks. If not removed, the animal eventually sets up inflammation of the iris and cornea, which ends in total loss of vision. A crescentic incision along the edge of the cornea allows of the escape of the animal along with the aqueous humor. Cases have been reported by many ophthalmic writers, among whom Mackenzie has given the fullest details, and has figured the animal both in its natural condition and magnified.[1]

All the operations on the cornea just described will be greatly facilitated by

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[1 See Greuning, N. Y. Med. Record, May 1, 1880.]

[2] This instrument was invented by Assalini for seizing the iris in the operation for artificial pupil; Ricerche sulle pupille artificiali, etc. Milano, 1811. For this purpose it has been superseded by the more delicate *canula-forceps*.

[3] In a case I communicated to the Dublin Journal of Medical Science (n. s., vol. vi., p. 210, 1848), a very minute scale of copper remained fixed in the iris for *eight years*, and, after causing repeated attacks of iritis, was at last thrust forwards against the cornea by the effused lymph; ulceration was set up, and the little fragment, projecting through the cornea, was seized and extracted.

[1] Mackenzie (Practical Treatise, etc., 4th edit., 1854) quotes a case of *cysticercus* in the anterior chamber, observed by Schott in 1830; another by Logan in 1833; and relates two cases of his own in 1848 and 1850, and two others in the practice of other surgeons. He also mentions a case reported by Appia, in which the cysticercus is *said* to have been seen within the substance of the cornea. In all these instances the *left* eye was affected, and Mackenzie remarks that "the left has suffered much oftener than the right eye from the intrusion of *cysticerci*, either under the conjunctiva or into the interior of the organ." Cases which have been reported subsequently to the publication of Mackenzie's work do not, however, bear out this statement. In the Archiv für Ophthalmologie, vol. i., p. 453, is a case of *cysticercus* in the *right* anterior chamber; and in the same journal, vol. iv., p. 113, is another, also in the right eye; Teale has reported a case occurring in the right eye; Ophthalmic Hospital Reports, vol. v., p. 320. When Mackenzie wrote, *cysticerci* had never been discovered in the *vitreous* chamber; but in the Archiv twenty cases have already been reported, nearly equally divided between the right and left eyes. (See a subsequent note on *cysticerci* on the retina and in the vitreous humor.)

the use of the spring speculum, a forceps to fix the globe, and, in irritable and timid patients, by the administration of chloroform [or ether].

The *after-treatment* of all the foregoing cases, in which an incision of the cornea may have been necessary for the removal of a penetrating body, mainly consists in keeping the eye perfectly at rest and protected from light, while the healing process is going on. For the first twenty-four hours at least, *both* eyes should be covered with a light bandage. After that period it may be sufficient to keep the wounded eye closed, and the length of time during which this closure should be maintained must depend upon the rapidity with which the wound heals, and the aqueous humor is re-secreted—circumstances varying according to the constitution of the patient, and the amount of violence inflicted on the eye by the accident and the subsequent manipulations of the surgeon. Patients should neither be kept low nor over-stimulated, but maintained as near as possible at their natural standard of vigor. Those of an irritable temperament will often require a narcotic for several nights after these operations; but if chloroform has been used a narcotic should not be given while the system is still under the effects of the inhaled vapor.

CHAPTER V.

DISEASES OF THE SCLEROTIC.

INFLAMMATION.

(*Rheumatic Ophthalmia* of Mackenzie; *Scleritis; Sclerotitis.*)

The sclerotic is inflamed to a certain extent in all cases of keratitis and iritis, and exhibits that zone of red vessels close around the margin of the cornea which is so marked a symptom of both these diseases. A more extended inflammation of the sclerotic not uncommonly forms one of the complications of catarrhal ophthalmia.

But there is also a form of inflammation which is almost limited to the sclerotic, the conjunctiva being implicated only in a secondary degree, and this sclerotic inflammation may assume either the acute or the chronic form.

In the acute inflammation the whole of the sclerotic is intensely injected, the part assuming a peculiar pink tint, quite different from the more vermilion color of conjunctival inflammation. In very severe cases the pink tint has a shade of violet, in consequence of the depth at which the vessels lie in the fibrous tissue. Intolerance of light and lachrymation are marked symptoms, and in and around the eyeball there is always considerable pain, which sometimes assumes the form of intense neuralgia throughout the ophthalmic division of the fifth nerve, extending even into the second and third divisions.

The attack is attended with general constitutional derangement; the tongue is coated, the appetite bad, and the urine often deposits large quantities of lithates.

Treatment.—The bowels must be first thoroughly cleared, and then narcotics given, in doses proportioned to the severity of the neuralgia and the former habits of the patient. Half a drachm, or a drachm, of tincture of hyoscyamus may be sufficient in some cases, while in others full doses of morphia will be requisite to insure sleep. In some patients quinine, in others iodide of potassium is of great service; to those in whom the rheumatic diathesis is more marked, colchicum given in combination with an alkali will be far more beneficial. The patient's appetite is usually so bad that it requires management to induce him to take sufficient nourishment. Beef-tea, bread-and-milk, and various modifications of farinaceous food, are often more readily taken than solid meat. Sugar should be avoided, and beer, as containing sugar; dry wine or diluted spirit being substituted, and of course only given in quantities demanded by the condition and previous habits of the patient. Local depletion by means of leeches seldom produces more than temporary benefit, and blisters only aggravate the neuralgia. Steaming the eyes over hot water is usually soothing, and preferable to fomentation, in consequence of the extreme irritability of the surface of the eye. The most effectual local application is chloroform, diluted with olive-oil according to the susceptibility of the skin, and applied on lint to the temple and forehead. The patient's room should be moderately shaded from light, and the eyes still farther protected, if necessary, by a suitable eye-shade, or tinted spectacles; but complete darkening of the room is unnecessary, and it has the great disadvantage of rendering the examination of the eyes by the surgeon intensely painful during the abrupt transition from darkness to light.

Chronic inflammation of the sclerotic occurs frequently, but by no means exclusively, in rheumatic subjects. Instead of involving the whole extent of the sclerotic at once, it commonly appears as a limited patch of redness, close to the cornea, after a time fading away, and then reappearing on some other portion of the white of the eye, but always keeping close to the cor-

neal margin. [This localized form of inflammation is usually called "*episcleritis*," as the tissue principally involved is the subconjunctival. The patches are of a dusky red color, and more or less raised above the surrounding surface.]

When this chronic inflammation of the sclerotic has gone on for a long time, it has a tendency to involve either the cornea or the iris. In the latter case the iritis is so insidious and so slightly marked as frequently to be overlooked; and it is not until after the sclerotic redness has wholly disappeared that some dimness of vision induces the surgeon to make a careful examination of the pupil; when he will probably detect some small adhesions between the iris and the capsule of the lens, or a filmy opacity of the latter, dotted with minute patches of pigment.

It appears to be this form of obstinate sclerotic inflammation which Wilde[1] has described as "inflammation of the ciliary body." No evidence, however, exists that this structure is specially the seat of inflammation. [Inflammation of the ciliary body, or *cyclitis*, generally occurs in connection with iritis (irido-cyclitis) or choroiditis, though it is occasionally met with as an idiopathic affection. When localized it may readily be mistaken for episcleritis, particularly as it is accompanied by marked congestion of the episcleral vessels. There is, however, less elevation of the surface and greater disturbance of the vision, and extreme tenderness on pressure.]

Treatment.— Chronic inflammation of the sclerotic is a very tedious affection, and one that is extremely liable to recur, if the patients are exposed to cold and damp, or fall into that dyspeptic condition which induces chronic rheumatism. Strict attention to diet, avoidance of sugar, and of substances which form sugar in the system, a dry and temperate climate, will be the best means to prevent the sclerotic inflammation from becoming periodical in its return. Quinine is commonly the most effectual remedy, and blisters to the temples are often valuable adjuncts. But if the patches of redness shift about from one side to the other, fading away at one part, only to reappear at an opposite point of the globe, a vigilant watch should be kept upon the iris, lest it should be attacked with inflammation. If the pupil becomes sluggish and slightly irregular, a careful examination with concentrated light will probably reveal a very slight, barely perceptible, deposit of lymph fringing the pupillary margin. The sight will at the same time be more or less cloudy. In such a case mercury must be carefully given to check the iritis. Two grains of calomel with half a grain of opium may be given at bedtime; or, if the iritis be more acute, and the deposit of fibrin more considerable, the calomel and opium may be given for a few days, night and morning; and as soon as the deposit begins to be absorbed, the dose may be restricted to two grains a day, or even that quantity may be given on alternate days. In delicate subjects a single grain taken every night may be sufficient from the first. The mouth must never be made at all tender, and the depressing influence of the mercury may be counteracted by a daily dose of bark, and a moderately nutritious diet. The bark should be continued in small doses for some weeks after the mercury has been left off.

[Atropia is always useful as an anodyne, and for the purpose of keeping the eye in a state of rest. When there is a suspicion of iritis, its use should never be omitted. Warm poppy fomentations are much used.]

[1] Medical Times and Gazette, n. s., vol. ix., p. 515, 1854.

Injuries of the Sclerotic.

Clean cuts of the sclerotic, inflicted with sharp bodies of various kinds, frequently involve the subjacent structures, the choroid and retina. If the latter be extensively divided, a greater or less quantity of the vitreous humor is almost sure to be lost. The laxity of the conjunctiva, however, often serves to limit the escape, as the tenacious fluid becomes entangled among the meshes of the subconjunctival areolar tissue.

The prognosis of wounds of the sclerotic depends upon their extent, the amount of vitreous humor which has been lost, and, above all, upon the fact whether or not the foreign body inflicting the wound has penetrated into the interior of the globe. The wound made by the entrance of a grain of shot is usually very small, as the elasticity of the sclerotic causes its fibres, after being separated by the shot, instantly to close up again, as soon as it had passed through them. When quite recent, a shot-wound in the sclerotic is hidden by a little patch of blood extravasated beneath the conjunctiva. The entrance of a grain of shot, or a fragment of metal, through the sclerotic into the vitreous chamber is almost certain to set up a slow inflammation of the whole globe, ending in loss of sight and atrophy of the organ.

Simple punctures and small cuts through the sclerotic, unattended with the retention of any foreign body, commonly unite very well, provided the eye be kept in perfect rest, and the reparative process

be not interfered with, and checked by injudicious applications, or by general depletion and weakening of the patient's system. It seems almost superfluous to insist upon the necessity for absolute repose for the wounded organ; and yet it is wonderful to see how the good sense of the surgeon, who would treat a fractured limb on the principle I have just mentioned, seems to desert him as soon as a wounded eye comes under his care.

Rupture of the sclerotic with displacement of the lens.—A very remarkable injury sometimes happens to the sclerotic, consisting in a laceration extending completely through its substance, within a line or two of the corneal margin, while the conjunctiva remains unbroken, and the dislocated lens, slipping out through the rent in the sclerotic, becomes firmly wedged beneath the conjunctiva.

This rupture of the sclerotic always takes place on the side of the eye opposite to that which has received a severe blow with some blunt body; the fibres, being suddenly put on the stretch, give way at the point where they are the most bent. Hence it is that the seat of rupture is almost always either the upper or the inner part of the globe, the lower and the outer portions being comparatively exposed to violence, while the prominence of the eyebrow above, and of the nose internally, defends the upper and the inner portions.

Rupture of the sclerotic, with sub-conjunctival dislocation of the lens, is always attended with some injury to the iris. Either that portion adjacent to the sclerotic wound is drawn into it, the pupil remaining large, and displaced towards the margin of the cornea, or else the shock causes the ciliary attachment of the iris to give way to a greater or less extent.

It sometimes even happens that the whole ciliary attachment gives way, and the entire iris is driven completely out of the globe, through the rent in the sclerotic, along with the aqueous humor, lens, and a portion of the vitreous body. This large escape of the contents of the globe only takes place, I believe, when the conjunctiva is also ruptured.[1]

When a recent case of ruptured globe is seen soon after the infliction of the injury, the parts are so obscured by blood that it is often impossible to form a correct estimate of the damage the globe has sustained. Detachment of the iris from its ciliary connection is always attended with bleeding, which may completely hide everything behind the cornea. The lens, too, if dislocated beneath the conjunctiva, is often enveloped in blood, so that its form cannot be precisely defined. Until the blood behind the cornea has been absorbed, it is impossible to ascertain whether the retina has retained its function; so that in every case the prognosis will be extremely doubtful.

Treatment.—If the detached iris is hanging out of the wound through a rent in the conjunctiva, it should be snipped off with scissors; but inasmuch as the lens, if lying between the unbroken conjunctiva and the sclerotic, may be so obscured by effused blood as to be with difficulty recognized, it will be well to wait a few days until the blood has become absorbed, and then the division of the conjunctiva covering the displaced lens will allow of its easy removal.

Absolute rest of the eye is the one important point in the treatment of all cases of ruptured globe. For the first few days, both eyes should be kept closed, by means of strips of plaster or a light bandage. Afterwards, it will suffice to close the injured eye only; but this closure should be uninterruptedly maintained for a week or ten days.

The patient should not be kept on low diet, nor depleted in any way; least of all should he be brought under the action of mercury, as is too often done. Such treatment can only have the effect of lowering his reparative power, and so retarding the process of cure.

[1] See two cases in which the lens and iris were driven out of the eye through the ruptured sclerotic, published in my Practical Guide, etc., 2d edit., pp. 398–9. Also a case of sub-conjunctival dislocation of both lenses in the same person, p. 113, note.

CHAPTER VI.

DISEASES OF THE IRIS.

Congenital Defects.

(*Irideremia; Coloboma; Misplaced pupil; Persistence of membrana pupillaris.*)

Congenital absence of iris (*irideremia*) always attracts the notice of those about the infant by the peculiar reddish glow which is reflected from the retina. The child seems to shrink from strong light, and there is a good deal of unsteadiness of the globes. The whole space behind the cornea presents one uniform red or orange tint, while the edge of the lens is marked only by a ring of golden light.

Although the term *irideremia* would imply a total absence of iris, a slight rudiment of it is often found, forming a very narrow segment of a circle skirting some portion of the edge of the cornea.

Considering that a certain number of

infants affected with this rare malformation are yearly brought for an opinion to our public eye-hospitals, it is singular that an adult thus affected is so seldom met with. I can only remember to have seen one such case, a short notice of which I published a few years ago.[1]

Coloboma.—This congenital malformation is the result of an arrest of development, whereby the coalescence of the two halves of the iris is prevented; the pupil, therefore, presents an elongated form, and extends down to the lower edge of the cornea.

A median fissure of the lower portion of the choroid accompanies *Coloboma iridis.* The iris and choroid being formed in the embryo from one vascular membrane curved upon itself, an arrest of development causes in both structures the same kind of defect along the median plane of the eyeball.

Coloboma iridis, however, is not always placed exactly on the median plane of the eye, but sometimes a little to the inner or outer side of it. It usually coexists in both eyes, although not always in the same degree. Sometimes, instead of the pupil being prolonged down to the bottom of the cornea, an abortive attempt, as it were, to form a coloboma is evidenced by a puckered groove in the iris, extending downwards from the lower edge of the pupil. The actual size of the pupillary aperture in coloboma is not always quite so great as, on a superficial inspection, it appears to be; for the extreme edge of the aperture, when minutely examined, will sometimes be found to be fringed with a blackish-brown pigment; and this at first sight produces the effect of a larger area than really exists.

An old prolapse of the iris through an ulcer, situated at the lower edge of the cornea, by drawing the pupil directly downwards, may produce an appearance a good deal like a *coloboma iridis.* The white cicatrix, however, in the former case, would always enable the careful surgeon to recognize the true character of the deformity.

[1] Guide to the Practical Study, etc., 2d edit., p. 400. Samuelson describes a case of *irideremia* in a man of forty-eight. Not only were the irides absent, but the closest scrutiny failed to detect any ciliary processes. His accommodation seems not to have been tested; but he asserted it to be perfect; British Med. Journal, 1863, p. 495. In the Monatsbl. für Augenheilk., 1866, *irideremia* is noticed as existing in a woman of forty-two. Her eldest child had the same defect. Hulme reports a case in a man aged twenty-two. He could read No. 6 of Jæger's test-types; Med.-Chir. Trans., vol. xliv. France gives another case, a woman aged twenty-three; Guy's Hospital Reports, vol. vii.

Another abnormal condition of the pupils consists in their being placed near the margin of the cornea, instead of opposite to its centre. Malposition of the lens appears frequently to accompany this eccentric position of the pupils.[1]

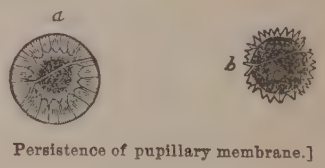
Persistence of the fœtal *membrana pupillaris* has been described as sometimes causing an obstruction in the pupil which might be mistaken for congenital cataract; but no practised observer could make such a mistake; for the *membrana pupillaris* is attached, not to the margin of the pupil, but to the anterior face of the iris, at a little distance beyond, where there is a more or less elevated ring of small tufts or nodules. Projecting from this part of the iris, I have occasionally seen slight vestiges of the pupillary membrane, in the form of little spurs or tags.

The persistence of any portion of this membrane, even in young persons, is a circumstance of extreme rarity. Dr. Cohn, in the Klinische Monatsblätter für Augenheilkunde, 1867 (p. 62), enters into an analysis of the cases published by different authors, and dismisses all of them except five as originating in a faulty diagnosis. He describes four cases from his own observation. I think there can be no doubt that, in most of the instances reported, old adhesions, the result of bygone iritis, have been mistaken for shreds of the membrana pupillaris.

The following case appears to be worthy of record, as exhibiting a vestige of the pupillary membrane in a person of middle life.

In the summer of 1867 a lady, aged thirty, consulted me for short-sightedness. The case was a very simple one, the myopia not in any high degree, and suitable glasses were all she required. I noticed a fine hair-like thread running obliquely across the pupil of the right eye, and at once recognized it as a vestige of pupillary membrane. It gave the patient no inconvenience, and indeed she could not be made aware of its existence under any

[Fig. 262. Fig. 263.



Persistence of pupillary membrane.]

illumination I could apply. Fig. 262 represents the eye with the pupil in its natural state, and Fig. 263 after atropine. I had expected to find that, as the pupil dilated,

[1] Figures of unusually extensive coloboma iridis, and of congenital malposition of the pupils, illustrate a paper of mine in the Ophthalmic Hospital Reports for 1858 (plate iv., figs. 2 and 3).

while the two sides of the iris were held together by the little thread, the aperture would become irregular; but this was not the case to any appreciable extent. The iris, of a thoroughly healthy appearance, was of a rust-brown, and the filament was only a little paler in color. At each end it had a bifid attachment, and looked like a portion of the proper fibrous tissue of the iris drawn out into a thread. Under the ophthalmoscope, the media and fundus of the eye presented nothing unusual.[1]

In the *Albino* the iris partakes of the general want of colored pigment which characterizes the hair and skin. The layer of opaque pigment, termed *uvea*, is altogether wanting, and the structure of the iris presents a singular appearance, as if loosened by maceration. Whitish fibres are intermixed with others of a lilac color, and through the whole attenuated iris the light reflected from the fundus of the eye transmits a reddish glow.

Albinism is frequently attended with defective vision, and always with great intolerance of light. In some cases, however, sight is very good, and extreme sensibility to light is the only thing complained of.

Inflammation of the Iris—Iritis.

Before entering upon this very important subject, it will be desirable to say a few words about the appearances which the iris presents in a healthy state; for it is subject to many variations as to color and mobility, which, if not rightly understood, may lead to serious errors of diagnosis; mere congenital peculiarities, or changes incident to age, being mistaken for signs of disease.

The iris presents every shade of bluish-grey and brown among the fair and the light-brown races of mankind; whilst among the negro races it is uniformly found of a dark brown, approaching to black. A parti-colored iris is not very rare; a fourth, a third, or even half of its surface being brown, and the rest bluish-grey: or one iris may be wholly brown, and the other as entirely grey, each eye being perfectly normal in respect of sight. Light-brown irides are often marked with two or three isolated tufts of dark pigment, and these spots are frequently causes of alarm to those who are the subjects of them.

A very slight tremulous vibration of the whole iris attends every movement of the eyeball in some persons, who nevertheless enjoy good sight; but this tremulousness must be regarded as morbid, whenever it exists to any great extent. It is quite independent of the movements of the pupil, and is best seen when that aperture is contracted, as a larger extent of iris is then open to observation. As a decidedly morbid appearance, tremulousness of the iris is familiar to us after those cases of extraction of cataract, where much vitreous humor has been lost, or after needle-operations, where that humor has been rudely stirred up and disintegrated.

The pupil is not placed precisely in the centre of the iris, but a little nearer to the median plane of the body; so that the iris is rather narrower between the inner edge of the pupil and inner margin of the cornea than on the outer side of the pupil.

Any considerable deviation of the pupil from a circular form may be regarded as the result of disease; but the pupil may exhibit, especially in elderly persons, a slight irregularity of outline, without any disease having existed in the iris.

The mobility of the iris becomes less as age advances; and, in old people, we often find a small and almost fixed pupil, the sight remaining excellent. In examining the mobility of the pupils, each one should be tested separately, the other eye being closed; for such is the sympathy between the two organs, that when, in consequence of disease in the nervous apparatus, an eye has become quite insensible to light, its pupil, otherwise motionless, will contract whenever light is admitted to the sound eye.

The earliest mention of *iritis* occurs in a treatise by Schmidt, describing the inflammatory changes consequent upon cataract-operations as performed in his day.[1]

It is impossible to overrate the importance of inflammation of the iris; for when we consider that the visual function of the eye ceases, if the small aperture of the pupil becomes closed, we at once appreciate the consequences of inflammatory effusion into its area.

The attention which has been bestowed upon iritis by ophthalmic writers has led many of them to indulge in minute and tedious subdivisions of the disease, and to distinguish them by complicated terms, which only serve to embarrass and confuse the practitioner. The extent to which this evil has spread can be fully appreciated by those only who are familiar with German medical literature.[2]

[1] This case has been already published in the British Medical Journal, March 20, 1869.

[1] Ueber Nachstaar und Iritis nach Staaroperationem, 1801.

[2] For remarkable instances of this mania for subdivisions and uncouth names, see the work of Von Ammon, De Iritide, 1836; and that of Rau, Die Krankheiten und Bildungsfehler der Regenbogenhaut, 1844.

This passion for subtle refinements and nomenclature has been comparatively rare with English writers; and those whose practical experience has been the most extensive have made use of the simplest classification.

Lawrence divides iritis into *acute* and *chronic*, and limits its constitutional modifications to four, the *syphilitic*, the *gouty*, the *rheumatic*, and the *scrofulous*. Tyrrell adopts the same arrangement.

There are certain signs common to all cases of iritis, under whatever constitutional modifications it may be developed; such are, a well-marked sclerotic zone; diminished mobility of the pupil, with more or less change in its form; a loss of the peculiar fibrous appearance of the iris; and a change in its color.

[Fig. 264.

Posterior synechiæ (Wells).]

Whenever there is a suspicion of iritis, atropia should be used. Even in the earliest, or hyperæmic stage, the pupil will dilate partially or irregularly; and if lymph has been effused, posterior synechiæ (Fig. 264) will be made evident, which might otherwise escape observation.]

Other signs mark the peculiar constitutional influence which has given rise to inflammatory action in the part. These will be noticed under the proper heads.

Traumatic Iritis.

Incised wounds of the iris are not the injuries which cause the greatest amount of inflammation in its tissue. On the contrary, clean cuts, even if very extensive, produce but little inflammatory reaction; while bruising, or continued pressure of the part, such as occurs in certain displacements of the lens, invariably gives rise to inflammation and adhesive deposits.

The wounds which are sometimes accidentally inflicted on the iris during the operation for extracting a cataract, or those which are intentionally made, to form an artificial pupil, are rarely followed by iritis; and when, after a few days, the eye is examined, more or less blood may be found at the bottom of the anterior chamber, but the fibrous tissue of the iris will present almost its ordinary aspect.

The lodgment of a foreign body, however, even of the smallest size, always sets up iritis, which does not permanently cease until the foreign body has been removed. As foreign bodies, before reaching the iris, must have passed through the cornea, I have thought it best to treat of them in Chapter IV., under the section "Injuries of the Cornea."

A singular accident which sometimes befalls the iris may be mentioned in this place, although it is really attended with very little iritis, namely, detachment of the iris from the ciliary ligament. The organic connection between these two structures is so slight that a smart blow with a stick or whip, the rebound of a twig, or the shock of a spent shot, is sufficient to sever them from each other; the extent of the separation varying in every possible degree, from a mere hair's-breadth to the complete detachment of the whole iris from its ciliary connection.

A very slight separation may almost escape notice. It appears as a small, black, elongated mark, close to the extreme edge of the cornea. In proportion to the extent of the separation will be the amount of deformity of the pupil; and when half of the circumference of the iris has been detached, the pupil will probably fall together and be wholly effaced.[1]

In all extensive cases of detachment, there is bleeding into the anterior chamber; sometimes to such an amount as at first to conceal the injury from view.

Unfortunately the surgeon can do very little in these cases. To replace the detached iris is utterly impossible, and vision must inevitably remain greatly impaired; but at least he can abstain from attempting to hasten the absorption of the effused blood by administering mercury. It may seem unnecessary to caution any one against such practice, but, in fact, the dogma that "mercury induces absorption," is so firmly fixed in some minds, that instances are constantly occurring of patients being actually salivated as a means of promoting the absorption of blood which is filling the anterior chamber after rupture of the iris. The rational mode of treatment is to defend the eye from strong light, and to keep the general vigor of the patient up to a healthy point, and then nature will in due time completely absorb the blood, without any aid from drugs.

I have observed how readily the iris inflames when subjected to long-continued

[1] The appearances presented by separation of the iris from its ciliary attachment may be seen in most of the illustrated ophthalmic works. I may instance Mackenzie's Treatise, 4th edit., p. 396; Cooper, On Wounds and Injuries of the Eye, 1859, pp. 170, 173, 175; Lawson, Injuries of the Eye, Orbit, and Eyelids; 1867.

pressure. The most striking examples of this are seen, when, in consequence of a blow upon the eye, the lens has been loosened from its connections, and partially dislocated into the pupil. The traumatic iritis is still more severe, if there be at the same time an incised wound of the cornea. In that case, the aqueous humor drains away, and, in consequence, the iris becomes compressed between the cornea and the displaced lens.

Inflammation of the iris soon sets in; vessels become visible in its tissue, and lymph is effused into the pupil, into which the lens is bulging. The cornea becomes hazy, and is traversed by vessels. The sclerotic and conjunctiva are deeply injected, and there is abundant secretion of tears. If the case be left to itself, or injudiciously treated, the pupil becomes eventually closed with effused lymph; or else the cornea softens and gives way. Meantime the deep tissues become disorganized, and, after protracted suffering, the patient finds the eye utterly useless.

The only way to anticipate all this mischief is to remove the displaced lens, which is acting like a foreign body. To do this requires much tact and care, and, in making the requisite opening in the cornea, the surgeon must endeavor to avoid isolating any considerable portion of corneal substance between his incision and the wound already existing in the cornea, lest the isolated portion should slough from interrupted nutritive supply. Sometimes the wound in the cornea is so placed that the surgeon, by enlarging it, can make an opening sufficient for his purpose. But if the wound be in the centre of the cornea, it is usually desirable to make the incision in a new portion, and as near the margin as possible. If the substance of the lens has been much broken by the original injury, the greater part of it will probably escape when pressure is applied; but if the lens be almost entire, it must be broken up as much as possible before any attempt at pressure is made. The use of the scoop will greatly facilitate the removal of the disintegrated lens, the pulpy substance escaping along the groove. In some cases the removal of a portion of iris will not only facilitate the removal of the lens with the scoop, but will prevent the occurrence or continuance of iritis.

The success of such an operation will depend upon its being performed soon after the accident, while the cornea is still clear, and before iritis and effusion of lymph have set in. If performed at a later period, there will be greater risk of vitreous humor being lost. In all cases the success of the operation, as regards restoration of sight, must be very doubtful. And if performed at a late period, relief of pain and prevention of complete disorganization of the globe will probably be the best result that can be hoped for.

The treatment, after such an operation as I have just noticed, will be similar to that after an ordinary case of extraction of a cataract. Closure of both eyes for four or five days will be necessary, and the reparative powers of the patient must not be depressed by privation of due nourishment.

The surgeon must not deceive himself with the belief that in these cases of wound of the cornea, with displaced lens, the administration of mercury can avert destructive inflammation. The efficacy of mercury in controlling the effusion of lymph in non-traumatic iritis, arises from the fact of there being, in that case, no foreign body—which a displaced lens really is—pressing against and irritating the iris. *Traumatic iritis*, set up by a displaced lens, is wholly beyond the powers of mercury, and its administration can only do harm, by lowering the patient's reparative power, and so unfitting him to recover from the operation, should removal of the lens be ultimately resorted to.

Rheumatic Iritis.

Rheumatic inflammation of the iritis assumes either an *acute* or a *chronic* character. In the former case, the attack can usually be traced to exposure to cold wind or damp, when the body has been exhausted by fatigue or greatly overheated.

According to the nervous susceptibility of the patient, the onset of an attack of rheumatic iritis will be attended either by dull pain in and around the eyeball, or by acute neuralgia throughout the first division of the fifth nerve, extending even to the second and third divisions.

When the attack is severe, there is usually a good deal of intolerance of light, and lacrymation. The vascular zone is not well-marked, on account of its being lost in the general injection of the whole sclerotic, which assumes the purplish tint I have described as characterizing sclerotic inflammation.

Rheumatic iritis is almost always attended with some slight haziness of the cornea, and in this respect it differs remarkably from the syphilitic form, which, even in the most severe cases, often leaves the cornea perfectly clear. The morbid changes in the iris itself are sometimes so slightly marked as to escape an unpractised or a careless observer; so that it is not until the inflammation has subsided, and the cornea has become quite clear, that the still-existing impairment of sight causes a more careful scrutiny of the pu-

pil to be made, and then inflammatory exudation into its area, and adhesion of its margin, are found to have taken place.

In the more acute form of rheumatic inflammation, the veins of the iris may be traced on various parts of its surface, as delicate red lines, diverging from the edge of the pupil to the periphery of the iris. I need hardly say that these fine vessels cannot be traced if there exists any considerable haziness of the cornea.

The pupil is contracted, more or less irregular, and as the inflammation goes on, this irregularity becomes more marked, in consequence of effusion of lymph[1] taking place between the edge of the pupil and the capsule of the lens. The insidious manner in which this fibrinous effusion occurs affords a marked contrast to the rapidity with which large masses of yellow or reddish-yellow lymph show themselves on the edge of the pupil in syphilitic iritis.

I have already noticed the neuralgia throughout the region supplied by the ophthalmic division of the fifth nerve, which attends an acute attack of rheumatic iritis. There is also very frequently considerable febrile disturbance, the urine being loaded with lithates.

The majority of cases do not present such acute symptoms as those just described, but pursue a more chronic course. The injection of the sclerotic being less general, the vascular zone around the cornea is better marked; there is little, if any, intolerance of light or lacrymation, and instead of severe neuralgia in the fifth nerve, there is only a dull aching pain in and around the eyeball.

But whether the iritis be acute or chronic, there is still the same danger of effusion of lymph into the area of the pupil, and this danger is, as I have said, all the greater on account of the gradual and insidious manner in which the effusion takes place. To check this is the main object to be kept in view.

Treatment.—If the early stage of acute rheumatic iritis be attended with severe neuralgia, as is frequently the case, the treatment will be much the same as that which I have described in Chapter V., as suitable to acute inflammation of the sclerotic. In some patients iodide of potassium, in others colchicum, will be of most service; while some cases, characterized by visible enlargement of the veins of the iris, yield to turpentine. I have usually given the Chian turpentine in substance, as pills, four grains three times a day. The condition of the pupil must be carefully scrutinized from day to day; and if it be found irregular and angular, or if any brownish tags appear to be forming at its edge, mercury must at once be given. Two grains of calomel, with a third or half a grain of opium, may be taken night and morning; and should any tenderness of the gums begin, the quantity ought at once to be diminished; for if salivation be allowed to occur, the neuralgia is almost certain to return, and the mercury, which in small doses was so beneficial, begins at once to exert its depressing influence. In delicate subjects it is often very useful to give a dose of bark—Battley's liquor cinchonæ or quinine—in the middle of the day, during the time the mercury is being taken. During the inflammatory stage the pupil is to be kept under the action of atropine.

It is almost impossible to lay down precise rules about diet. It should not be *low*—that is to say, innutritious—but light and easily digestible: soup, bread-and milk, farinaceous food of various kinds, with or without a proportion of meat, according to the patient's digestive powers and previous habits. Stimulants should be given only in such quantities as may be necessary to sustain the circulating forces. Feeble and depressible persons may require a certain amount of dry wine, or diluted spirit, while those addicted to habitual indulgence may only eliminate the rheumatic poison which they have stored up in their blood, by abstinence from the alcohol and sugar they have so long abused.

Occasional steaming of the eye over hot water is the most soothing local application, and where neuralgia is present, is preferable to fomentation by means of wetted compresses.

Leeches to the temples may occasionally be found useful at the onset of an acute attack; but where neuralgia exists they commonly do harm, and they should never be applied to feeble and depressible subjects, or to those liable to erysipelas. Blisters also have the disadvantage of exasperating neuralgia. They are, however, very serviceable in the chronic form which often succeeds the acute attack, and they certainly aid in removing that haziness of the cornea, which, if not promptly dispersed, is apt to become permanent.

[1] In describing iritis, I shall frequently have occasion to speak of that exudation from its vessels which constitutes the most serious feature of the disease, by forming adhesions between the pupillary margin and the capsule of the lens, or wholly blocking up the area of the pupil with opaque membrane. Whether this *exudatum* becomes itself converted into fibrous tissue, or whether it only influences the cells of the tissue among which it is effused, and causes new cells to be developed from those already existing, is a physiological question which can hardly be decided. I have used the term "lymph" to describe this *exudatum*, because the word is familiar to all my readers, and is sanctioned by long usage.

Syphilitic Iritis.

Inflammation of the iris originating in syphilis is very frequently associated with other forms of secondary or tertiary disease, especially with eruptions on the skin. It is by far the most marked kind of iritis, and is characterized by a tendency to rapid and abundant inflammatory exudation on the iris, especially about the edge of the pupil, in which situation yellow, reddish-yellow or nearly red nodules sometimes attain to such a size as almost to close up the pupillary area.[1]

The cornea is either clear, or marked throughout its lower half by very minute dots, of a pale buff tint. These dots are as small as if pricked in with the point of a pin, and are so closely set together as to suggest to a superficial observer the idea of a faint cloudy haze. It often happens, however, that even these minute dots are wholly absent, and the cornea, during an acute attack of iritis, remains perfectly transparent.

There is always a vascular zone in the sclerotic, but not that generally diffused redness of the eyeball so frequently present in rheumatic iritis. Neither, as a rule, is there intolerance of light, which is one of the most marked symptoms of the rheumatic form.

Irides which have naturally a bluish tint, when attacked with syphilitic inflammation, appear more or less green. This is caused by the presence of yellow albumen in the aqueous humor, the admixture of the yellow and blue forming, of course, a green tint. This fact may be demonstrated in some of those old cases in which chronic iritis has attacked an eye again and again, until sight has been lost, nearly all the tissues having undergone a morbid change. If in such a case the cornea be carefully punctured with a broad needle, and the fluid of the anterior chamber caught in a spoon, the application of heat will at once show the presence of albumen; and if the iris have been originally bluish, that color will be restored as soon as the last drop of the yellow fluid has drained away from the anterior chamber.

When a patient has syphilitic iritis for the first time, it may attack both eyes together, or may be limited to one eye. When relapses occur, the inflammation usually affects the right and left eye alternately; and these attacks may come on without the patient having contracted any fresh primary disease.

Syphilitic iritis is so much modified by the condition of the patient, that the surgeon must take care not to form to himself any arbitrary idea of the appearances, or expect to find in every case the strongly-marked and unmistakable proofs afforded by large nodules of exudation around the pupil. In fact, iritis may exist to such an extent as to produce serious and permanent obstruction to the pupil, without any development of these nodules. In some cases the lymph is uniformly distributed around the margin of the pupil, which then assumes a thickened ring-like appearance, the rest of the iris exhibiting little, if any, deviation from its healthy aspect. The loss of its mobility, however, is always well marked, even in the slighter cases; and, indeed, the sluggishness or total immobility of the pupil, when exposed to light, is one of the most valuable diagnostic signs of iritis in its early stage.[1]

Occasionally the nodules of lymph, instead of appearing on the edge of the pupil, are situated on the greater circle of the iris, in the re-entering angle formed between it and the cornea. Such cases are comparatively rare.

[The yellowish-red nodules found on the iris in specific iritis are thought to be identical with the gummy tubercles (gummata) found in other organs. They sometimes nearly fill the anterior chamber. Similar deposits also occur in the ciliary body, and may cause thinning of the sclerotic, and ciliary staphyloma, and end in destruction of the eye. They are best treated by mercurials and by iodide of potassium pushed to the limits of toleration.]

In every case of iritis, the surgeon should most carefully examine the area of the pupil, to determine whether it be or be not overspread with lymph. This sometimes exists merely as a very thin film, which may escape detection, unless light be concentrated upon it by means of a lens of short focus. Such a film, however, if not speedily removed by proper treatment, will rapidly become thickened by fresh deposits, and, growing more and more opaque week by week, will eventually form a serious obstacle to the transmission of light.

The so-called "closure of the pupil," justly regarded as the most serious termination of unchecked iritis, is caused partly by the nodules of lymph which are thrown out upon the margin of the pupil,

[1] In Sichel's Iconographie (Plate xiii., fig. 5), is a good representation of a mass of lymph, reddened with vessels, at the edge of the pupil.

[1] I cannot point out any really good representation of iritis in its early stage. Indeed, it is hardly possible for an artist to convey a true notion of the delicate changes in form and color which characterize the disease at that period.

and unite it to the capsules of the lens (*synechia posterior*), and partly by fluid exudation of the same inflammatory kind, which overspreads that portion of the capsule corresponding to the pupillary area. This exuded fluid, as it solidifies, forms organized connections with the nodular deposits on the edge of the pupil, and eventually, by its contraction, draws the margin of the pupil together, and permanently blocks up its greatly diminished space with a tough, firm, and opaque membrane.[1]

[Fig. 265.

Syphilitic iritis (after Lawrence).]

Treatment.—From what has been said, it will be seen that the leading principle in the treatment of syphilitic iritis consists in procuring as quickly as possible the absorption of the lymph which has been effused in and around the pupil. To effect this, the most powerful agent is *mercury*. But when we consider the variety of constitution in patients attacked with syphilitic iritis, the impaired state of general health they frequently exhibit, in consequence of venereal taint, and the period at which the iritis sometimes occurs —namely, while they are only just recovering from the debilitating effects of salivation—it is evident that, in a treatise like the present, little more can be done than to indicate the outlines of treatment, and that the judgment and tact of the surgeon must be brought to the careful study of each individual case.

When a recent case of syphilitic iritis comes before us in a patient of good general power, we may at once order two grains of calomel, with a third or half a grain of opium, to be taken night and morning; first clearing the bowels, if necessary, by a rapidly-acting aperient. In private practice, where our patients are not necessarily exposed to the weather, the calomel may be given more frequently, but in smaller doses; a grain, for instance, every four hours, combined with just enough opium to prevent purging.

The effect of the mercury must be judged of by the state of the eye, not by the soreness of the gums. Indeed, I look upon soreness of the mouth as a condition to be always avoided, if possible; never to be willingly produced, as is so often the case. As soon, therefore, as the gums begin to be at all affected, the calomel is to be given less frequently; the absorption of the lymph in the pupil being the test of the mercury having been effectual. The two-grain pills may be taken once instead of twice a day; the grain every four hours changed to the same quantity every twelve hours, and then taken at twice that interval of time. [Inunction is a favorite form of administration of mercury with many surgeons. It has the advantage of being easily controlled, and acts promptly without disturbing the stomach. In severe cases, blood is usually taken from the temple by leeching, or by the use of Heurteloup's artificial leech.]

A patient sometimes comes before us with recent iritis, which has come on while he was actually under the influence of mercury, given for venereal disease. What are we to do in such a case? Perhaps we shall find that the patient, while taking the mercury, has been kept on very low diet, deprived of all animal food, and restricted to "slops." In that case, the mere change to a better diet—animal food and other nutriment being given, with a moderate quantity of the stimulant to which he has been accustomed—will often effect a surprising change, and stop the further effusion of lymph; while iodide of potassium, with bark, or, if the patient be extremely depressed by the mercury, even quinine alone, will at once cause absorption of the lymph to begin.

Or a directly opposite state of things may exist. The patient may have sought relief from the depressing effects of too much mercury by indulging in stimulants, and in this way may have induced an irritable condition of the circulation, quite incompatible with a due interchange of material in the system. Restriction of stimulants within due bounds will be as essential in this case as their use had been in the case of the ill-nourished and anæmic patient.

If a patient has been attacked with syphilitic iritis while under the depressing influence of too much mercury, given for general syphilis, and it has been found necessary to suspend the use of the mercury until tonics and a change of diet should have improved his general health, we shall often find that by resuming the mercury in *small* doses, while at the same time we continue the tonics, the iritis will

[1] This form of obstruction is sometimes called "spurious cataract;" but the term is manifestly improper, as the word "cataract" should be strictly limited to opacity of the lens itself.

yield, although it may have resisted the large doses which had been given under circumstances of over-stimulation or deficient nutrition.

Turpentine was recommended by Carmichael, as a substitute for mercury, in those cases to which I have alluded as unsuitable for the administration of the latter, on account of general debility. I have, however, found more benefit from the use of iodide of potassium, or even of very small doses of mercury, combined with tonics and improved diet, as above described. [It is the general practice to use iodide of potash in all cases of syphilitic iritis.] I have sometimes found turpentine of service in cases of rheumatic iritis, characterized by hyperæmia of the iris and sclerotic, but unattended with much disposition to effusion of lymph.

Whether the iritis be treated with mercury or not, the pupil is to be kept dilated by means of atropine [gr. iv to ℥j of water, repeated three or four times a day].

Syphilitic iritis has often a tendency to become *chronic;* each relapse being characterized by a slight sclerotic zone, a yellowness of the aqueous fluid, giving a greenish tint to blue irides, general dimness of sight, and a slight filmy deposit in the area of the pupil. This chronic form is chiefly found in patients who are subjects of tertiary syphilis, and a carefully-regulated course of iron often affords the best means of treatment.

In describing iritis, I have hitherto spoken only of those changes which are visible under ordinary observation; but the ophthalmoscope has demonstrated to us, what we formerly could only guess at, namely, that in so-called iritis the *retina* is often more seriously affected than even the iris itself.

To attempt to examine the retina during an acute attack of iritis, would be not only useless, but injurious; for the lymph deposited in the pupil, and perhaps in the vitreous humor also, would prevent any clear view of the parts behind; while the glare of light would be almost certain to increase the already existing hyperæmia of the organ. We often, however, have the opportunity of examining the retina after all inflammation has passed away, leaving the cornea, lens, and vitreous humor transparent. We can then fully appreciate the close connection between syphilitic inflammation of the iris and of the retina, and understand why it is that in cases of so-called "iritis," the dimness of vision is often out of all proportion to the changes in and about the iris.

One of the sequelæ of iritis (I use the word "iritis" in its more extended sense) is a cloudy condition of the vitreous humor, in which filaments and shreds, varying in shape and size, float freely in every direction. These bodies, though really whitish, of course appear black, or nearly so, when seen against the illuminated retina. They appear to be inflammatory deposits, intermixed in some instances with broken-up hyaloid membrane.

The retina presents still more varied marks of syphilitic inflammation. The optic nerve appears greatly enlarged, irregular in its outline, and of a homogeneous whitish texture. It is probable that in such cases we do not see the real tissue of the optic nerve, but only a layer of lymph overlying it. The vessels emerging from the nerve are small and shrunken. Large, irregular, white patches are scattered over the retina, in some cases involving the greater part of its surface. These appear to be portions of the nervous coat infiltrated with lymph, and no longer permeated by vessels. Patches and dots of black pigment are frequently seen scattered over and among these opaque portions of the retina. (Plate XI., fig. 2.)

Hence, it appears that syphilitic inflammation, when it attacks the eye, may exhibit its chief phenomena in the iris, involving the retina only to a very slight extent; or both structures may be equally affected; or lastly, the retina may suffer in such a degree as to almost become useless, while the iris shows little, if any, sign of inflammation, and the patient is hardly aware of the eye being the subject of disease, until vision is found to be almost lost.

Syphilitic Iritis in Infants.

Iritis is one of the rarest forms in which hereditary syphilis manifests itself during infancy. The careful researches of Mr. Hutchinson,[1] however, have shown that it is not quite so rare as has been supposed; and it probably often escapes notice on account, as he observes, of the very small amount of local symptoms which it causes, coupled with the fact that infants usually keep their eyes shut. Within the last ten years I have seen but five or six cases of syphilitic iritis in infants, among the many thousands of patients whom I have treated at the Moorfields Hospital. Some of these infants presented the stunted and unhealthy aspect which usually accompanies inherited syphilis; but two, whose cases I have elsewhere reported in full,[2] were well-grown children.

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[1] The result of Mr. Hutchinson's observations is given in A Clinical Memoir on certain Diseases of the Eye and Ear, consequent on Inherited Syphilis, etc., 1863.

[2] A Guide to the Practical Study of Diseases of the Eye, 2d edit., 1859, p. 149.

One of the most striking peculiarities of iritis in infants is the very slight development of a sclerotic zone, that unfailing sign of iritis in the adult. Indeed, in some of the cases I have seen, sclerotic redness could hardly be said to exist.

The infant at the age of from two to ten months is attacked with copper-colored eruption; perhaps also with mucous tubercles about the genitals, aphthæ in the mouth, and "snuffles." The eyelashes fall off, and sometimes the nails also are partially detached. In some cases the skin presents a peculiar dusky tint, and is wrinkled and scurfy.

The lymph does not assume the form of solid tubercular masses on the edge of the pupil, as in the adult, but either fills the area of the pupil, as a pale yellow semi-fluid mass, or sinks down to the bottom of the anterior chamber, like ordinary *hypopyon*. In one of the cases I saw, the lower half of the iris was completely hidden by a nodular mass of lymph, of a pale buff tint, which came into contact with the cornea, and completely filled the anterior chamber as high up as the middle of the pupil.[1] In another case the effused lymph—for such it seemed to be—was scattered all over the lower half of the iris in the form of little, grayish-white, semi-transparent granules, like grains of coarse sand. The pupil was fringed with the same kind of deposit.

Treatment.—Before speaking of any special medicines for infants affected with syphilitic iritis, I would remark on the absolute necessity for their being suckled, and not brought up by hand. The milk of a healthy wet-nurse would of course be infinitely preferable to that of an infected mother; but in the lower classes of society, among whom this disease is almost exclusively met with, the services of a wet-nurse can hardly be obtained.

Mercury should at once be given; and as hydr. c. cretâ is very uncertain in its chemical composition, I always make use of calomel, giving from a quarter of a grain to half a grain night and morning. The effect of the medicine must be carefully watched from day to day, and as soon as the lymph begins to disappear from the eye, and the cutaneous eruption to fade, the dose may be gradually diminished; but it will often be necessary for the mercurial treatment to be continued, in a modified form, for several weeks. [Inunction is particularly adapted to the case of infants. It may be conveniently applied by diluting mercurial ointment with lard, and spreading it on the "binder" over the abdomen.] Weakly infants will be much benefited by taking five minims of Battley's liquor cinchonæ twice a day in a little milk. Provided the child sucks and digests well, the mercury does unmixed good, and by counteracting the venereal poison, not only frees the skin from the specific eruption, but imparts to it a healthy hue, instead of the peculiar dusky color which was originally so evident.

A few drops of a solution of atropine containing two grains of the sulphate to an ounce of water, may be put into the eye once a day. So powerful a poison cannot safely be used without limit to young infants, even in its diluted form.

Scrofulous Iritis.[1]

Most of the patients in whom I have observed this form of iritis have been between five and fifteen years of age, and all have shown signs of a scrofulous constitution.

The iritis presented a resemblance to the syphilitic inflammation of adults, in respect of the abundant exudation which took place on the iris, and in the anterior chamber; but in the severer cases of the scrofulous form there was a still greater disposition to enlargement of the veins of the iris, and infiltration of its whole tissue, than is usually met with in syphilitic cases. In scrofulous iritis the large masses of yellow deposit are not so frequently limited to the margin of the pupil, but often appear midway between the pupil and the outer circle of the iris, or at the latter point, just in the angle between the iris and the cornea. Slight bleeding not unfrequently takes place into the anterior chamber, from giving way of the distended veins of the iris.

The cornea usually remains clear, but it sometimes presents a slight degree of mottled opacity, especially towards the lower part.

Treatment.—In the treatment of scrofulous iritis, as in all scrofulous affections, the diet and general mode of life deserve the utmost attention. Abundance—not excess—of animal food; warm clothing; pure air—sea-air, if attainable—are all important adjuncts to the medical treatment. Cod-liver oil is often of great service, and may be taken in combination with the other remedies. The bowels are usually irregular, and the appetite bad; and a mild aperient will be occasionally required; but care should be taken to avoid drastic purgatives, such as scammony and jalap.

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[1] Guide to the Practical Study of Diseases of the Eye, 2d edit., 1859, p. 149, fig. *a*.

[1] This form of iritis is not usually admitted. The cases described by the author are classified as purulent or syphilitic.]

When there is abundant inflammatory exudation into the anterior chamber, without much enlargement of the veins of the iris, or development of a sclerotic zone, half a grain or a grain of calomel at night, and two or three grains of quinine, or ten or twelve minims of liquor cinchonæ, taken an hour or so after a meal, will often produce a rapid absorption of the effused fluid. Where the exudation assumes the solid form, infiltrating a considerable portion of the iris, or appearing at its inner or outer circle as large yellow nodules, reddened with vessels, the iodide of iron is often useful, both in promoting the absorption of the deposit, and in diminishing the vascularity of the iris itself.

All stimulating lotions must be avoided; nor, indeed, except atropine, is any local application of service.

Gonorrhœal and Arthritic Iritis.

I have never been able to trace an attack of iritis as a result of simple gonorrhœa; although, of course, it may often happen that a patient is attacked with ordinary rheumatic iritis within a short period of his having had urethral discharge. Gonorrhœa is unfortunately so common, that were there any definite form of iritis dependent upon it, so marked a sequela of the discharge would be constantly brought under our notice.

Neither have I seen cases of iritis which I could refer to gout. The descriptions of "arthritic iritis" one meets with in books are chiefly taken from German writers, especially Beer and his contemporaries, whose account of the disease, which they term *gouty* inflammation, more nearly answers to that of chronic glaucoma. The ash-colored ring in the sclerotic, immediately surrounding the cornea, described by German writers as the *arthritic* ring or circle, and regarded by them as diagnostic of arthritic iritis, is not peculiar to any special form of inflammation. Its presence merely depends upon the anatomical arrangement of the adjacent portions of the sclerotic and cornea. When these two structures are united obliquely, so that a considerable extent of the sclerotic is overlapped by the cornea, the vessels of the former do not appear to advance so near to the iris as in other cases; and hence a narrow ring, of a paler tint, is interposed between the iris and the dense plexus of vessels forming the sclerotic zone.

[In a rare form of iritis a peculiar spongy or gelatinous exudation appears in the anterior chamber, which it may fill. As this grayish mass does not reach the extreme periphery of the anterior chamber, it presents a sharply defined edge, beyond which the iris is seen, and has a striking resemblance to a dislocated and opaque lens, for which it has been mistaken.]

Use of Atropine in Iritis.

In a former edition of this work I spoke unfavorably of the employment of atropine during the acute stage of iritis. Subsequent experience has led me to modify my opinion on this subject. Of course the action of atropine will be most evident in those cases where the inflammation is quite recent, and where consequently the tissue of the iris is not, as yet, much thickened by congestion of its vessels, nor infiltrated with lymph. Where abundant effusion of the latter has taken place around the margin, and within the area of the pupil, atropine may not produce any change visible to the observer; but when this stage of effusion has not yet arrived, or when, at a later period, it is passing off, persistent dilatation of the pupil may be induced by atropine, and such dilatation will have the effect of hindering the formation of adhesions between the iris and the capsule, or of causing such adhesions, if already existing, to give way. In all cases of iritis, therefore, a solution of atropine should be dropped upon the eye night and morning. Where the inflammation is recent, and atropine is used in anticipation of lymphatic effusion, rather than to counteract the solidification of deposits already formed, a solution of two grains of the sulphate of atropia in an ounce of distilled water, may be employed; but in the more acute cases a solution of double that strength will be required.

Not contented with insisting on the utility of atropine as an adjunct to mercury in the treatment of iritis, some recent writers have even gone so far as to recommend that the disease should be treated by the use of atropine alone. More dangerous trifling I cannot conceive. No doubt cases of iritis occur in which the tendency to effusion of lymph can hardly be said to exist at all, and such exceptional cases may possibly get well without any mercury being given. But we are not warranted in assuming that a case of iritis which begins in a mild form is going to maintain that character throughout, and it is our duty to employ that agent which above all others has the property of counteracting the effusion of lymph, and the consequent loss of transparency in parts essential to vision. And what rational cause is there for this anxiety to avoid the employment of mercury? Used ignorantly, as we too often see it used, mercury is a fearful curse to

mankind; but moderately and judiciously used it is one of our greatest blessings. If patients with iritis are to be so impregnated with mercury that profuse salivation and all the other miseries of mercurial poisoning are induced, they may well pause before submitting to a remedy almost as bad as their disease. But this kind of mercurial treatment is never necessary. Those cases of iritis commonly do best where the mouth has not even been made tender, and therefore there is no real necessity for the attempts that are being constantly made to treat iritis without mercury. We are often told that iritis will get well without it—and so no doubt it will, in a certain sense, get well without any treatment at all. But what is meant by "getting well?" A wound gets well when a sufficient deposit of organizable material has taken place between the divided surfaces; and the denser the cicatrix, the more thorough is the cure. Or a case of hydrocele "gets well" when the walls of the sac are thoroughly glued together by abundant inflammatory deposit. But the eye is in one respect a wholly exceptional organ. Once let its transparent tissues become opaque, and then, although the eye may in a certain sense have recovered from an inflammatory attack, the function of the organ is impaired or destroyed. The treatment of iritis consists in speedily preventing the formation of patches or films of inflammatory deposit in the transparent media of the eye, and if mercury has the invaluable property of doing this, it seems criminal in the surgeon to neglect the use of it.[1]

It is a curious fact that in certain persons the application of sulphate of atropia to the conjunctiva will set up all the symptoms of acute catarrhal ophthalmia. I do not speak of solutions to which a few drops of acid or of alcohol have been added. Such additions, I know, are sometimes made; but they are as unnecessary as they are irritating, for well-made sulphate of atropia is quite soluble in distilled water. The first instance of my meeting with this effect of atropine occurred several years ago, in a hospital in-patient who used drops from the same solution that was being dispensed at the time to many hundreds of others, none of whom experienced any similar inconvenience. As soon as the drops were discontinued, the conjunctival inflammation rapidly subsided, and it was again excited by a reapplication of the atropine. I have recently met with another case, in which great irritation, both of the eye and eyelids, followed the use of drops which I myself applied and knew to be perfectly neutral.

[It has recently been recommended to substitute duboisia for atropia when this idiosyncrasy, which is rare, exists.]

[1] Remarks on the use of atropine in iritis almost identical with the above, were to have been added to the third edition of my Guide to the Study of Diseases of the Eye, 1866, but by inadvertence they were not sent to the printer.

Sequelæ of Iritis.

Besides the changes already mentioned as resulting from iritis, such as obstruction, or closure of the pupil, the inflammation is sometimes followed by degeneration of structure, which more or less involves the whole tissue of the iris.

Chronic iritis, for instance, in a cachectic subject, especially if the disease has been allowed to run on unchecked, is apt to induce a permanent thickening of the iris, all appearance of its normal fibrous tissue being lost, and the veins of the part becoming enlarged and irregularly dilated.

On the other hand, the constant pressure of a calcified lens, which has become thrust forward against the iris, will sometimes induce such wasting of its tissue, that the uvea wholly disappears, and the thin web of iris which remains allows the chalky-white lens to be distinctly seen through it.

Another consequence of iritis is the distension of the iris into *pouches*, which are formed in the following way. An attack of syphilitic iritis, left to itself, or badly treated, causes the whole margin of the iris to adhere to the capsule of the lens; the pupillary area being, at the same time, very small, and filled up with opaque deposit. All communication between the anterior and the posterior aqueous chamber is cut off; and the aqueous fluid secreted in the latter cavity, not being able to pass through the pupil into the anterior chamber, accumulates behind the iris, and gradually distends and presses it forwards; the pupillary margin meantime being prevented from advancing with the rest of the iris in consequence of its union with the capsule.

[Posterior synechia, by preventing the free movement of the pupil when the muscular fibres of the iris contract, become a source of irritation, which frequently excites attacks of *recurrent iritis*. In such cases a wide iridectomy should be made; but it is safer to operate in the intervals of the attacks than during the existence of acute symptoms.]

If the uveal surface, except just at the edge of the pupil, be free from adhesion, the whole anterior surface of the iris becomes one convex mass, with a deep depression at its centre, in the position of

the closed pupil; but if the uvea be here and there adherent to the capsule of the lens, the iris at those spots remains retracted, like the pupil, while intervening portions of iris are thrown into a series of pouches which may almost, or quite, touch the cornea. These pouched portions of iris lose their fibrous appearance, and have a dark, slaty tint.

Vision, in such cases, is reduced to mere perception of light; but, provided the retina be sound, excellent sight can often be restored by means of a carefully-planned and skilfully-executed artificial pupil.

In cases of long-continued iritis, combined with disease of the choroid, and of the anterior portion of the sclerotic, the iris not only becomes united to the capsule, and bulges forwards in the manner just described, but the fluid secreted in the posterior aqueous chamber, continuing to accumulate, exerts pressure on the anterior portion of the sclerotic, and stretches its weakened tissue. This gradually yields, and forms a *staphyloma sclerotic*æ, a tense, bluish-black prominence, streaked with the widely-separated whitish lines of the sclerotic fibres. At first, while the prominence is small, it is usually situated at the upper part of the globe just behind the cornea; but the distension may go on until the whole of the sclerotic, between the line of insertion of the recti muscles and the margin of the cornea, forms one bulging lead-colored swelling. *Staphyloma sclerotic*æ is always a sign of the deeper tissues of the eye having suffered from disease, and, if developed to any considerable extent, would contra-indicate operations for artificial pupil or cataract.

Cysts of the iris.—In very rare cases a punctured wound of the iris, near its ciliary attachment, has been followed by a cyst-like expansion of its substance, in consequence, apparently, of the fluid of the posterior aqueous chamber finding its way between the uvea and the fibrous tissue of the iris.

These cysts present a dark slaty tint, which nearly approaches to black when their walls become very thin [or may appear as translucent vesicles]. The treatment of these cases is often extremely troublesome, on account of the readiness with which the expanded iris-tissue reunites after being lacerated. When the lens is *in situ*, and transparent, the difficulty is greatly increased.[1] [The treatment now generally adopted is to remove the cyst, together with the segment of iris to which it is attached, by iridectomy.]

[1] See a case reported at length in my Guide to the Study of Diseases of the Eye, 2d edit., 1859, p. 408.

Operations on the Iris for Artificial Pupil.

Many of the diseases and injuries affecting the iris and cornea, described in the foregoing chapters, produce complete closure of the pupil, while others either cause it to become displaced from its natural position, or leave it more or less completely hidden behind a dense corneal opacity.

All operations for the relief of such obstructions or malpositions of the pupil may be suitably described in this place; while the operation on the iris, for the cure of *glaucoma*, must be deferred until that disease has been considered.

The term *Artificial Pupil* must be understood to include not only the formation of a new aperture in the iris, when the portion forming the natural pupil has prolapsed through a breach in the cornea, but also the reopening or the enlargement of the natural pupil when obstructed by inflammatory deposit; or the displacement, towards a transparent part of the cornea, of a pupil which has become overshadowed and hidden behind a dense corneal opacity.

Before attempting any form of operation for artificial pupil, the surgeon must make himself thoroughly acquainted with the history of the case, and especially ascertain for himself the following conditions:—

First, whether the eye perceives light: mere obliteration of pupil will not deprive the eye of this power, provided the retina be sound; for we know, by personal experiment, that even the thickness of our closed lids does not prevent our noticing the shadow of a hand passing between our eye and the window.

Secondly, the presence or absence of the lens must, as far as possible, be ascertained, and, if present, whether it is transparent or opaque.

Thirdly, the cornea must be carefully examined, as to its degree of transparency.

Fourthly, the state of the iris itself must be noticed. The existence of chronic iritis would induce the surgeon to defer the operation until the inflammation had ceased. A thickened iris, in which all trace of its peculiar fibrous structure is lost, is specially unfitted for an operation, as it breaks away under the slightest traction, and, if cut, the wound does not gape, so as to form a permanent aperture.

As a rule, it is not desirable to operate for artificial pupil when the other eye is perfect.

The principle, not to inflict unnecessary injury on the parts operated upon, which holds good of every surgical operation, applies with peculiar force to that for an

artificial pupil; for often the portion of transparent cornea is very small, and a needlessly large cicatrix may seriously diminish the patient's field of vision.

Generally speaking, a small artificial pupil is more useful than a large one; that is to say, if it can be made in such a position that all the cornea in front of it is transparent. Sometimes, however, the pupil has to be drawn from behind an opaque corneal cicatrix; and in that case it is only by making a large aperture that a sufficient portion of it can be rendered available.

Inasmuch as the natural pupil is placed nearly in the centre of the iris, it would follow that a similar position must be the most suitable for an artificial aperture. Various considerations, however, may induce the surgeon to select a more peripheral situation; but he should always strive to approach the centre of the iris, as far as circumstances will allow.

Peculiar care is required in the examination of those cases, frequently brought under our notice, in which the greater part of the cornea appears converted into a more or less prominent, densely opaque, white cicatrix, after severe purulent or gonorrhœal ophthalmia. The patient may have good perception of light, and there may be an appearance of a narrow strip of semi-transparent cornea adjacent to the sclerotic, suggesting the possibility of an artificial pupil being made. And yet the appearance of a true corneal tissue may be altogether deceptive.

When the whole cornea has been destroyed by ulceration, as in severe purulent ophthalmia of infants, or the gonorrhœal ophthalmia of adults, the iris is for a time laid bare; but very soon exudation takes place on its surface, while the iris, yielding to the pressure behind, gradually forms the prominence known as *staphyloma*. The greater part of this fibrinous coating of the iris eventually becomes white and opaque, and traversed by ramifying vessels; but the marginal portion of the iris is covered by a semi-transparent tissue, united, perhaps, to a very narrow ring of true cornea, just that portion immediately connected with the sclerotic. No space, however, exists between this semi-transparent, cornea-like tissue, and the fibres of the iris; and any attempt, therefore, to make an artificial pupil in this situation would only end in disappointment.

The different modes of making an artificial pupil may be classed under four heads: *laceration*, *incision*, *excision*, and *ligature*.

1. *Laceration.*—This consists in tearing away a certain portion of the iris from its ciliary attachment, and is so unscientific, clumsy, and ineffectual an operation, that I should not even mention it, were it not sanctioned and recommended by many continental authorities in ophthalmic surgery. Near the margin of the cornea an incision is made, through which a sharp hook is introduced, and then carried across to the opposite side of the anterior chamber. Here the hook is stuck into the iris, and then drawn back towards the corneal wound. This traction causes the ciliary attachment of the iris to give way; and when the iris has been separated to the extent desired, the hook is detached and withdrawn from the eye.

An artificial pupil of this kind involves almost all the faults it is possible to include in one operation. Its position, opposite to the margin of the cornea, is the worst that could possibly be chosen; the size of the rent cannot be accurately limited; the vessels and nerves of the iris are torn just where they are largest; the great circular vein, surrounding the iris, pours out a quantity of blood, which partly or wholly fills the anterior chamber, and is not readily absorbed; if the lens be present, there is considerable risk of wounding it with the hook, which, in its withdrawal, is frequently caught in the corneal incision. It is to be hoped that this operation, if not already obsolete, will speedily be consigned to the limbo of exploded surgery.

2. *Incision.*—This is the oldest form of operation for artificial pupil, being that employed by Cheselden in a case commonly spoken of as the first in which an artificial pupil was made. The operation is founded on the elasticity of the fibres of the iris, which causes them to retract when cut across, so as to leave an aperture for the transmission of light to the retina. Hence it will be seen that the operation is likely to succeed in proportion to the state of tension and retractile power of the iris, and will be inadmissible in those cases of closure of the pupil resulting from chronic iritis, or any other disease of the iris which has caused softening and degeneration of its tissue. The operation by incision would also be contra-indicated if the lens were present, as injury to it must almost inevitably follow the penetration of the iris by a cutting instrument.

The operation, therefore, is much restricted in its application, and is almost confined to those cases in which, after extraction of a cataract, there has been prolapsus iridis to such an extent as wholly to obliterate the pupil, the fibres of the iris remaining on the stretch in consequence of so large a portion becoming healed into, and confounded with, the corneal cicatrix.

The incision is made either with a cutting-needle or a fine narrow knife, or else

with scissors. The needle or knife is passed into the anterior chamber close to the edge of the cornea, and when the point has been carried a little beyond the middle of the iris, the cutting edge is turned backwards, the point is made to penetrate the iris, and its fibres are divided to such an extent as may be desired. The needle or knife is then rotated into its original position and withdrawn.

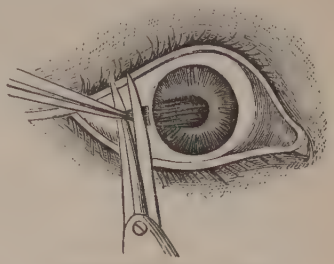
Maunoir[1] modified the operation by using scissors for dividing the iris; but of course they required a large corneal wound for their introduction, and neither the linear nor the V-shaped incision which he recommended was found by any means easy to accomplish when the iris had become flaccid after the escape of all the aqueous humor. If scissors are employed at all, the canula-scissors, invented by Wilde, would be found far more convenient for incising the iris, as they may be so constructed as to cut their own way into the cornea, and fill up the wound they make, thus retaining a good deal of the aqueous humor.

[This operation has recently been revived under the name of iridotomy, by Wecker, who has invented a pair of scissors for its performance.]

In cases where a very narrow strip of cornea alone remains transparent, after sloughing or ulceration throughout the rest of its extent, it becomes of the utmost importance to accomplish the division of the iris with as little injury to the cornea as possible. In such cases I have found the most useful instrument to be a broad needle, cutting on both sides for a short distance from its point.

3. *Excision* [*Iridectomy*].—In cases where the pupil had become drawn together, and its contracted area blocked up with an opaque membrane, in consequence of iritis, the lens being unaffected, the operation of incision, either by the knife or scissors, was contra-indicated, since it was hardly possible to puncture the iris with a cutting instrument without wounding the lens. The operation of excision therefore became necessary, which was performed as follows: an opening of sufficient size having been made in the cornea [at its margin, with a lance-shaped keratome], a forceps was introduced into the anterior chamber; its branches were then opened, a portion of iris was included between them, and, being grasped, was drawn out of the corneal wound, and cut off with scissors. [See Fig. 266]. The objection to this operation was the difficulty of limiting the quantity of iris removed; the pupil was usually very large, and extended almost, if not quite, up to the border of the cornea.

[Fig. 266.



Iridectomy (after Wells).]

The "blunt hook," invented by Tyrrell, introduced a more delicate and precise mode of operating; and for special cases, has not been superseded by any subsequent contrivance. It requires only a very small corneal wound for its introduction; and it can be employed without risk in cases where the lens is *in situ* and transparent. [In this country, at least, the forceps are generally preferred; the blunt hook is rarely used.]

It is specially adapted for the following cases: First, when, after extraction, there has been extensive prolapse of the iris, so as to obliterate all but a very small vestige of the pupil. Secondly, when, in consequence of iritis, the whole pupillary margin has become adherent to the capsule, the peripheral portion of the lens itself remaining transparent. And, lastly, when the iris is perfectly healthy, but the pupil is hidden behind a dense central opacity of the cornea, the rest of the cornea remaining clear.

a. In a case such as I have alluded to under the first head, we will assume the lens to have been extracted through an upper section of the cornea. The artificial enlargement of the pupil would be made in the following manner: the lids being held apart with a spring-wire speculum, the surgeon steadies the globe by nipping up with a forceps a little fold of ocular conjunctiva, just above the upper edge of the cornea; he holds in the other hand the broad cutting-needle, which he passes through the lower edge of the cornea, close to its junction with the sclerotic. If the width of the blade be properly proportioned to the size of the hook, a simple puncture will suffice; but if the needle be narrow, its edges may be used to enlarge the wound to a sufficient extent. The needle should now be gently withdrawn; not with a jerk, as such a movement is usually followed by a spurt of aqueous humor, and it is important to retain as much of that fluid as

[1] Mémoires sur l'Organisation de l'Iris et l'Opération de la Pupille artificielle, Paris, 1812.

possible. The surgeon then takes the blunt hook, and passes it in through the corneal wound, the flat side of the hook coming in contact with the iris. The instrument, held in this position, is rapidly passed upwards, until its extremity reaches the small pupillary opening; then the handle is rotated so as to allow of the lower edge of the displaced pupil being firmly caught in the bend of the hook; gentle traction is then made, and at the same time the handle is again rotated in such a manner that the short bent portion faces directly forwards. It is only in this position that the hook can be withdrawn through the corneal wound without catching in it; and it is for the want of attending to this little manœuvre that those who use the blunt hook so frequently find a difficulty in withdrawing it. When the hook, holding the iris, has been fairly brought out of the wound, an assistant, with a pair of fine scissors, snips through the iris, close to the hook, if a good portion of iris has been secured; but should the iris have torn, and only a small portion been withdrawn, it may be desirable to cut through it close to the cornea. Sometimes the tissue of the iris is so much softened that it breaks in coming out, and the surgeon must use a fine forceps to catch what remains, and so prevent its retracting into the anterior chamber.

Any little shreds of iris that hang in the wound should be returned by means of a little spatula, so that the lips of the wound may come into exact apposition.

The description just given of the mode of using the blunt hook, and of other details in the operation for artificial pupil, will apply to the different modifications subsequently described. The wire speculum, and forceps to steady the globe, will always be found useful, often indispensable. The patient should lie down on a couch; and the best light is usually obtained by the foot of the couch being turned towards the window; the surgeon standing or sitting behind the patient's head. The use of chloroform will be regulated by circumstances; it is commonly necessary with children, or very intractable patients; but the pain of the operation, when skilfully performed, is so trifling, that patients possessed of self-control can usually dispense with chloroform altogether.

b. The next class of cases in which the blunt hook should be employed is that where iritis has terminated in adhesion between the whole or the greater part of the pupillary margin and the capsule of the lens.

At p. 94, under the head "Sequelæ of Iritis," I have described such a condition of closed pupil, accompanied by a bulging forward of the iris, in consequence of the pressure of the fluid secreted in the posterior chamber of the aqueous humor. When the whole surface of the uvea has become adherent to the capsule of the lens, these pouch-like dilatations of the iris do not exist. When only the extreme edge of the pupil adheres, the rest of the uveal surface remaining free, the contracted pupillary area, blocked up with opaque membrane, remains fixed, while the iris bulges all around it, so as in some places to touch the cornea. Partial adhesions of the uvea to the capsule give rise to deep grooves, subdividing the iris into separate pouches; the accumulation of fluid behind the iris being unable at these points to thrust it forwards.

When the whole cornea is clear, and the surgeon can select the position in which to make an artificial pupil, he will find it best to extend it either directly outwards, or directly downwards; and in a case of pouched iris, such as I am now considering, if a depression in the iris exists in either of these directions, he may take advantage of the circumstance to insinuate the cutting-needle and hook between the cornea and iris, without risk of wounding the latter.

When, however, he has succeeded in catching the edge of the pupil, and drawing out a piece of iris, he may perhaps be disappointed to find that he has removed only its fibrous portion, and that the aperture he has made is still blocked up by a layer of uveal pigment, adherent to the anterior capsule. Although in such a case the first operation may have done but little towards restoring sight to the patient, it will be found to have greatly facilitated a second operation, as the fluid which had been pent up in the posterior aqueous chamber can now find its way into the anterior chamber, and, in consequence, the whole iris will lose its pouched appearance, and recede from the cornea. When the slight irritation caused by the first operation has passed off, the cutting-needle may be introduced at a new point of the cornea, the edge of the artificial pupil caught with the blunt hook, and drawn in such a direction as to remove a portion of iris which had never been adherent to the capsule. If the periphery of the lens be transparent, this second operation will at once open a way for the rays of light to pass to the retina.

c. Extensive ulceration at the centre of the cornea, stopping short of actual perforation, may leave a cicatrix so large and opaque as entirely to cover the pupil, restricting the patient's sight to the perception of large objects placed very much out of the line of direct vision. The iris itself, when viewed through the transparent periphery of the cornea, may present

a perfectly healthy appearance, and there may be every reason to suppose that the whole globe, with the exception of the cornea, has been unaffected by disease. In such a case, the object of the surgeon will be to displace the pupil either outwards or downwards, accordingly as he finds the outer or the lower portion of the cornea preferable in respect of transparency. The blunt hook is the most convenient instrument for effecting this displacement, as it does not endanger the lens, which I am supposing to be perfectly healthy. An opening having been made, either at the outer or lower margin of the cornea, in the manner described at p. 97, the free margin of the pupil is to be caught with the hook and drawn out, a larger or smaller piece of iris being cut off according to the size of the corneal opacity beyond which the pupil is to extend.

4. *Ligature.*—In spite of every precaution, it is not always possible to limit the size of the pupil, which sometimes opens out to an extent greater than was originally intended. To remedy this inconvenience, Critchett suggested an operation which he termed "Iriddesis,"[1] and which is applicable to a limited number of other cases of artificial pupil, besides that just described; as, for instance, where prolapsus iridis has occurred, and so much of the pupillary margin has been drawn into the cicatrix as to reduce the area of the pupil to a very minute aperture; or where the whole pupil has been displaced towards the extreme edge of the cornea, and there overshadowed by an opacity. A puncture is made through the cornea sufficient for the introduction of a canula-forceps; a small portion of the iris near its ciliary attachment is grasped, drawn out through the wound, and tied there with a very fine silken thread. This transforms the pupil into an elongated slit. Should this aperture be found insufficient, it may afterwards be enlarged by tying a second portion of iris in such a position as to draw the pupil into a triangular form.

The operation by *ligature* has the advantage of leaving the margin of the pupil uninjured; and in some cases it has been found that even a certain amount of dilatation and contraction of the aperture has been maintained. [This operation has been found to be dangerous, and may be considered almost obsolete.]

It is far from my intention, in treating of ophthalmic surgery, to attempt a record of all the schemes that have been suggested or put in practice. To describe the operations and instruments which artificial pupil alone has called forth, would be to enumerate a long and tedious catalogue of inventions, most of which have been long since abandoned as useless.

After-treatment of an artificial pupil.—The various forms of operation I have recommended in the foregoing pages, if skilfully performed, inflict so little injury on the eye, that, provided the parts be in a fit state to undergo the operation—all inflammation being extinct, and the patient's general health having been properly attended to—little more than repose of the eye is required to enable the cornea to heal; and when that is effected, the wounded iris soon regains its natural texture and appearance. We are often, however, obliged to operate on an iris which has undergone long-continued and repeated attacks of inflammation. The tissue of such an iris is soft and spongy, and its enlarged vessels, when torn or cut, pour out their blood into the anterior chamber, where it may remain for many weeks, or even months, without being absorbed. On the contrary, when the iris is sound, and the patient's health good, but little blood is effused into the anterior chamber, and that little commonly undergoes absorption in the course of a few days.

After an operation for artificial pupil, *both* eyes should be lightly bandaged, or the lids closed with strips of plaster. [Atropia is generally applied immediately after the operation.] On the second or third day the eye may be examined. Should there be much sclerotic redness, or intolerance of light, the operated eye must be again closed for a day or two. In most cases, at the end of a week from the operation, a large eye-shade will be sufficient; but the patient must be warned against too soon exposing the eye to strong light; and if the case be one in which the patient has for several years been limited to perception of light, he must be forbidden to strain his newly-regained powers of sight by premature examination of small objects. A pair of tinted glasses should be worn for some time after he has begun to go out of doors.

If the operation has been performed under chloroform, it will not be advisable to give any opiate or narcotic at night; but in excitable patients, who have not taken chloroform, it is sometimes necessary to give some mild narcotic. From twenty-five or thirty minims to a drachm of tinct. hyoscyami, in camphor-mixture, is what I usually order as a night-draught for an adult who has not been habitually addicted to the use of opiates. But many patients do not require anything of the kind. There is no reason for denying the patient a moderate quantity of plain animal food on the day of the operation, as well as on the following days. Nor should stimulants be wholly forbidden to those who are accustomed to their daily use. I

[1] *Iriodesis* or *Iridodesis* would be a more correct word to imply tying (δέσις) of the iris, inasmuch as the genitive of ἶρις is ἴριος or ἴριδος.

need hardly say that a patient who is to spend the first day after the operation in bed, and perhaps the rest of the week in the house, is not to live as freely, and have the same amount of stimulants, as if he were taking daily exercise, and were engaged in active pursuits. But, on the other hand, it is absurd to keep a patient on low diet, and deprived of all accustomed stimulants, because a small puncture has been made in his cornea, and a little bit of his iris removed. Old and feeble persons cannot bear such reduction; and if any considerable quantity of blood has escaped into the anterior chamber, the best way to hasten its absorption is to keep the patient's powers up to a healthy standard, by plain nutritious diet, and just such an amount of stimulants as will maintain the circulation at a proper point of vigor.

It is difficult to conceive how surgeons who wrote and practised within the last forty years, could have thought it necessary to resort to the depleting and starving treatment we find them recommending as necessary, after the operation for an artificial pupil. Little more than forty years ago, the late Mr. Guthrie,[1] in a work professing to teach the operative surgery of the eye, wrote as follows: "As a general rule, the patient should be *bled largely after any of the operations* for the formation of an artificial pupil;" and he goes on to say, that this bleeding is to be to the extent of fourteen ounces, in some instances to twenty-four, or from that to thirty ounces; that if the diminution of pain be only temporary, and after a few hours begins to increase (which, in an irritable or neuralgic patient, it would be quite sure to do, after all this loss of blood), recourse must again be had to bleeding; and that if *this* should not be sufficient to arrest the progress of the disease, it must be immediately treated as a case of iritis, and mercury administered in such a manner as to affect the system as rapidly as possible.

Such was the treatment by which a simple, delicate, and almost painless operation was perverted into a cause of suffering and misery.

CHAPTER VII.

DISEASES OF THE CHOROID AND RETINA.

(*Amaurosis—Amblyopia—Impaired Vision—Hebetudo Visus—Choroiditis—Retinitis.*)

The synonyms at the head of this chapter—and their number might be greatly multiplied by quoting from the older writers on eye-diseases—will at once show the difficulty that has always existed in assigning definite terms to those defects of sight which depend upon diseased states of the choroid and retina.

While some writers have classified these diseases *subjectively*, as they are evidenced to the patient by his own perceptions, and have spoken of "impaired vision," "amblyopia," and "amaurosis," others have attempted an anatomical arrangement, which before the invention of the ophthalmoscope was purely speculative and arbitrary, and have assumed inflammation of the choroid or retina to be the material *objective* cause of the phenomena.

The ophthalmoscope has already dissipated much of the mystery which formerly surrounded the deeper tissues of the globe, and has enabled us to demonstrate morbid changes, the very existence of which could only be vaguely suspected before the ophthalmoscope was invented. But when we remember how considerable a portion of the visual apparatus is contained within the cranial cavity, there must always remain a large class of defects of sight, which, like other cerebral diseases, can admit only of a theoretical and uncertain diagnosis.

Choroiditis.—Of course a structure like the choroid, almost wholly composed of a mass of bloodvessels, cannot fail to play an important part in all hyperæmic conditions of the eyeball. But that choroiditis, as a separate and independent disease, can be distinguished by such well-defined symptoms as are described in the older ophthalmic works, is disproved by the revelations of the ophthalmoscope. Patients are daily to be met with who have long suffered from defective sight, in degrees varying from a state in which it is difficult to read or to distinguish minute objects, up to that condition of dimness in which merely the form of large objects can be faintly discerned: to ordinary observation the eyes may appear quite sound, the pupils being active, and every tissue presenting the aspect of perfect health; and yet the ophthalmoscope may at once reveal morbid changes, which could only have been produced by extensive and long-continued disease of the choroid, portions of this structure having undergone atrophy to such an extent as wholly to have disappeared, leaving the sclerotic exposed to view; masses of pigmentous deposit overspreading the greater part of the choroidal surface, or effusion of serum having occurred in such quantity as to have detached a considerable portion of the retina from its position.

Retinitis.—As with the choroid, so it has fared with the retina, in respect of its

[1] Lectures on the Operative Surgery of the Eye, 2d edit., 1827, p. 510.

supposed diseases and their symptoms. In the older ophthalmic works precise and distinctive descriptions are given of the symptoms of retinitis, which we now know to be altogether fanciful and imaginary. One of the most extensive forms of retinal inflammation, that originating in syphilis, is proved by the ophthalmoscope to be a not unfrequent associate of the disease which still retains the restricted name of "iritis;" and yet, while this syphilitic inflammation of the retina is going on, there are none of the symptoms of retinitis, as formerly described by ophthalmic writers.

In patients who have long experienced impairment of vision, terminating in total loss of perception of light, the ophthalmoscope not unfrequently exposes to our view an amount of deposit on the retina, both opaque and pigmentous, such as could only have resulted from active inflammation; and yet, the progressive failure of sight has been painless, and quite unattended by any symptoms analogous to those formerly received as indicating retinitis.

If it be said that these are instances of *chronic* inflammation, and that the *acute* form must certainly be attended with all the phenomena of hyperæsthesia of the retina, the ophthalmoscope again contradicts the old opinions. Cases occur in which a sudden cloud appears to come before one eye, shrouding all objects in a dense mist, or wholly destroying the perceptive power of a large portion of the retina. No pain whatever occurs in the eye, nor is the patient sensible of any luminous appearances; while the iris and all superficial parts remain perfectly unchanged. Let the pupil be dilated, and the ophthalmoscope applied, and the greater part of the retina will be seen overspread with blood, poured out from some ruptured retinal vessel; and yet the hyperæmia, which must have preceded such rupture, may have been unattended with any subjective sensations of light.

In fact the terms *retinitis* and *choroiditis* originated in a desire to apply a precise and anatomical nomenclature to morbid conditions altogether obscure. Before the invention of the ophthalmoscope, this nomenclature passed unchallenged; for neither the active disease, nor the morbid changes resulting from it, could be investigated in such a manner as positively to prove or disprove the surgeon's diagnosis; and he pronounced a case to be choroiditis or retinitis, according to the preconceived notion he might have formed as to the effects which such inflammations would produce on vision.

The term "amaurosis," which but a few years ago formed a heading to the longest chapter in every work on eye-diseases, and a title to many an elaborate monograph, must now be consigned to oblivion; unless it be retained to designate those conditions of dim or lost sight the causes of which, being within the cranial cavity, are therefore beyond the range of actual inspection.

Morbid Appearances of the Retina, Optic Nerve, and Choroid.

Any verbal description of the various changes in the deep tissues of the eye, which the ophthalmoscope exhibits to our view, must of necessity be very imperfect; such a description may, indeed, recall to memory peculiarities of form and color which have already been studied in the living subject; but to the beginner it can suggest only a faint and shadowy picture. In many instances, too, we must content ourselves with describing appearances, the real nature of which we are at present unable to explain.

Retina and optic nerve.—In old persons, whose dimness of sight would suggest the existence of commencing cataract, we occasionally find a *white patch* of variable extent, and very irregular outline, immediately surrounding the optic nerve. Sometimes this patch is of such extent as to encroach upon that portion of the retina corresponding to the axis of vision. These patches are of an opaque dead white, and are quite devoid of vessels. They seem to be due to chronic hardening and condensation of the nervous tissue, with obliteration of the vessels. In some instances, perhaps, fatty degeneration may also be present.

In several cases of Bright's disease, accompanied with great dimness of sight, yellowish-white spots have been seen scattered over the surface of the retina. I am acquainted with only one case in which the fatty nature of these deposits has been proved by dissection.[1]

[1] The case is reported by Heymann, in the Archiv für Ophthalmologie, vol. ii., p. 139, 1856. During the progress of the disease the patient became maniacal, so that the ophthalmoscopical examination was difficult. The loss of sight was almost total in both eyes. The media were clear, and an irregular yellowish-white patch was observed just below the optic nerve. Both eyes were examined after death, and presented nearly similar appearances. At a distance of a line or two from the optic nerve, about twenty yellowish-white spots, of various sizes, were arranged in an irregularly circular figure. The largest spot which had been seen during life was situated below the optic nerve, and about a millimetre in diameter. A microscopical examination of the spots proved them to be isolated portions of fatty degeneration in the ganglionic structure of the retina.

[Retinitis albuminurica is now a well recognized form of retinal disease. It occurs most frequently in the later stages of chronic kidney disease (particularly the contracted kidney) and has frequently been the means of detecting it when it had not been suspected. In a typical case of albuminuric retinitis, the retinal veins are engorged and tortuous and the optic disc is swollen, has usually a striated appearance and its margin is obscured by congestion and serous infiltration. The vessels are also obscured in spots by exudation. There are numerous hemorrhagic extravasations, which are chiefly in the internal or fibrous layer and, therefore, striated. There are large white patches in the neighborhood of the disc which coalesce into an opaque zone; and around the macula are a number of small white spots arranged in a stellate or radiating form, appearing as if they had been "splashed in with a small brush." Numerous post-mortem examinations have revealed fatty degeneration of the connective tissue, especially of the external granular layer, and hypertrophy and sclerosis of the nerve fibres. The prognosis is, of course, unfavorable, though considerable improvement sometimes takes place. (Plate II., fig. 2.) A close approach to these ophthalmoscopic appearances is sometimes, though very rarely, met with where the kidneys are not affected, particularly in cases of cerebral disease, but in a great majority of cases they are pathognomonic of nephritic disease, and repeated examinations of the urine should be made if albumen is not detected in the first, particularly if the specific gravity is low. Impairment of vision sometimes also occurs in the course of Bright's disease from uræmic poisoning. It is usually sudden and transient, and the ophthalmoscopic appearances are negative.]

The changes in the retina and optic nerve consequent upon syphilitic inflammation have been already noticed in the section on iritis (p. 91).

A very remarkable appearance connected with the optic nerve in myopic persons, consists in a white patch, of a crescentic shape, so immediately in contact with the margin of the nerve as to seem at first sight to form part of the nervous tissue itself. The nerve in these cases is always found to deviate from its normal circular form, and to assume more or less that of an oval, in contact with the narrow diameter of which the white patch is found. As a rule it is placed to the outer side of the optic nerve, but it may be found above, below, or to the inner side. This crescentic patch has been described by German writers under the name of "staphyloma scleroticæ posticum," from a supposition that there is always at this spot an actual protrusion of the sclerotic.[1] This does not appear, however, to be invariably the case.

[There is no local bulging at the spot corresponding to the crescent, but a general distension of the posterior part of the sclerotic, causing a stretching and consequent atrophy of the choroid at the edge of the disc.]

In an eye which presented the crescentic patch in a very marked degree, it was found on dissection that the pigment-cells of the choroid were altogether wanting throughout the whole extent of the crescent; so that the light from the ophthalmoscope, passing through the transparent retina and wasted choroid, was reflected from the sclerotic itself, which at this point was thinner than natural, but not at all prominent or staphylomatous.[2]

[This atrophic "crescent" or "conus" is nearly always met with in high degrees of myopia—always in the progressive form.]

Among the more striking appearances under the ophthalmoscope are the irregular deposits of *black pigment* on the illuminated field of the retina. These pigmentous deposits present endless varieties as to quantity and mode of arrangement. In one case two or three minute isolated dots may alone be visible; in another case the pigment may assume the form of fine threads, ramifying over a considerable portion of the retinal surface; while, in a third case, the pigment may be aggregated in large black masses, the intervening portions of retina being of healthy appearance. (Plate XI., fig. 1.)

[*Retinitis pigmentosa.*—This is usually congenital, and frequently hereditary. Its symptoms are hemeralopia (night blindness), and a gradual concentric narrowing of the field of vision.]

Pigmentous deposits are met with at all ages, and generally appear to be a sequel

[1] E. Jæger, Beiträge zur Pathologie des Auges, 1858, plate xvii. A representation is here given of a well-marked crescent, fringed with pigmentous deposit, which was observed in a very short-sighted patient. Plate xviii. shows a still larger crescent, in a case of more advanced myopia. This figure also exhibits the choroidal vessels with that extreme distinctness which is caused by absence of the hexagonal pigment.

[2] See a plate in the first volume of the Ophthalmic Hospital Reports, Figs. 4 and 5. The nerve in both these figures is over-colored, so as to present too marked a contrast to the whiteness of the crescent. The dissection by Dr. Bader, alluded to above, will be found at page 117 of the volume just quoted. Good representations of the myopic patch in various forms are depicted in tab. iii. of Liebreich's Atlas.

of chronic inflammation, although it very often happens that the patient can give no account of such an attack. Pigment is also commonly seen interspersed in large quantities among the white patches which result from syphilitic disease of the retina.

When a vessel, in either the choroid or the deeper portion of the retina, has given way, and broken up the tissues immediately surrounding the extravasation, absorption of these tissues, as well as of the blood, may subsequently take place to such an extent as to lay bare the sclerotic. A rounded white patch is thus produced, which is usually fringed with a black edge of pigment. In other cases the whole site of the extravasation becomes covered with pigment, so that, instead of a black ring, an irregular black disc is the result. I have met with several instances in which a fringed or blackened patch of this kind was situated directly in the axis of vision. Sight was very imperfect, and limited to a very small space; so that, in the attempt to read a large type, only a single word, or part of a word, could be taken in at a glance.

Extravasations of blood, either from the retina or the choroid, constitute, I need hardly say, the most serious accidents to which those tissues are liable. [The effect of retinal extravasations upon the sight depends upon their location; if they occur at the macula, distinct vision is destroyed; if they are peripheral and not very large, it may be but slightly disturbed.] The blood may be effused in consequence of a blow on the eyeball, or it may escape spontaneously from a distended vessel giving way, as in ordinary apoplexy.

It is remarkable that rupture of a retinal vessel sometimes occurs without any of the symptoms which one might expect would accompany it—such as giddiness and other signs of cerebral disturbance. I have seen many cases in which a dimness or cloudiness has suddenly overspread one eye, while the patient, in apparently good health, was quietly engaged in reading or writing; no pain or uneasiness of any kind accompanying the attack, the iris retaining its mobility, and even the conjunctiva and sclerotic showing no trace of increased vascularity. The patient finds that a considerable portion of his field of vision has become a total blank as regards perception of objects; while, perhaps, he still retains the power of dimly discerning those which happen to fall on some limited portion of the retina. If such a case is examined within a few hours, or even a few days after the rupture of the vessel, the fresh red color of the effused blood will at once be recognized. If it is one of the radiating vessels of the retina that has given way, the prognosis will be much more favorable than if the hemorrhage had come from the choroid; for, in the former case, the tissue of the retina, although for a time overspread with blood, and so rendered incapable of receiving visual impressions, may have escaped any serious disintegration; whereas, if the blood has proceeded from the choroid, it may have actually ruptured the retina, and irreparably destroyed that portion of it as far as its function is concerned. The presence of clots freely floating in the vitreous humor would be a still more unfavorable sign, as it would prove that the tissue of the vitreous body had, to a certain extent, been broken up. This latter complication more frequently results from blows on the eyeball than from spontaneous apoplectic extravasation.

No one who has had a little practice with the ophthalmoscope can find any difficulty in detecting a recent extravasation of blood on the surface of the retina; but the recognition of the changes which mark the site of old extravasations is often extremely difficult. I have already noticed the cases in which a rupture of choroidal vessels breaks up and destroys a limited portion both of the choroid and retina, leaving either a well-defined space of white sclerotic, or a patch of dark pigment, to mark the site of the disruption. But a less extensive extravasation, originating in the rupture of a superficial vessel of the retina, may leave such faint traces as almost to escape observation. Sometimes the site of the rupture is marked by a slight brownish stain, in other cases by a faint mottling of the retinal surface; while a more extensive extravasation may so far damage the retina as to leave in after years a linear or stellate cicatrix (if one may so term it), of a lighter color than the surrounding tissue.

Serous effusion between retina and choroid.—This effusion may occur as a result either of acute or chronic inflammation; *chronic* effusion between the retina and choroid may take place in the most gradual and insidious manner, so as only to manifest itself by impairment of vision, unattended with any pain or external signs of inflammation.

When the retina has become detached to a very considerable extent, a corresponding portion of the field of vision becomes a total blank so far as perception of objects is concerned; while that portion of the retina which remains in apposition with the choroid may still distinguish even small objects, although in an imperfect and partial manner.

There are no external signs by which we can ascertain the existence of effusion

beneath the retina. The ophthalmoscope alone enables us to detect it.

The effused fluid may either exist in such a small quantity as barely suffices to impart a cloudy appearance to a limited portion of the retina; or it may have detached a considerable extent of the retina, or even the whole of it, from its connection with the choroid.

The more limited effusions frequently occur in the immediate neighborhood of the optic nerve. At first sight they appear as grayish or cloudy patches in the midst of healthy tissue, and the radiating vessels which are spread out over the rest of the fundus of the eye appear to be lost when they arrive at the edge of the patch. This appearance is owing to the fact of the vessels being raised up by the effusion beneath them, so that they are on a plane different from that of the vessels of the healthy retina. A slight movement of the convex glass, which the ophthalmoscopic observer is employing, will at once bring into focus the vessels overlying the effusion.

When a large portion of the retina has been separated, it presents the appearance of a lobular mass, of an opaque grayish color, contrasting in a remarkable manner with the reddish surface of that part of the retina which still retains its natural position. Sometimes the lobular mass may be observed to oscillate with each movement of the eye; and when brought into focus the surface of the mass is seen to be overspread with ramifying vessels, the displaced veins of the retina.

When almost the entire retina is detached from the choroid, the appearances under the ophthalmoscope are at first very difficult to understand. The whole fundus of the eye appears at one moment of a dull gray, as if covered with a milky gelatinous deposit; when the white disc of the optic nerve comes for an instant into view, and then again a sudden turn of the eyeball affords a glimpse of some very limited portion of undisplaced retina, which still dimly reflects the luminous rays which fall upon it. Not unfrequently the view of the fundus is still farther confused by floating bodies dispersed through the vitreous humor.[1] [Detachment of the retina occurs most frequently in highly myopic eyes, as a result of the distension of the coats of the ball.]

Coloboma of the choroid.—This very curious congenital malformation is associated with coloboma iridis (p. 84), and it presents under the ophthalmoscope a most remarkable appearance. The optic nerve is with difficulty distinguished, as it is in the midst of a large, oblong patch of white, across which some long scattered vessels are seen to ramify. This white patch is the sclerotic, exposed to view by the great gap in the choroid. The sheath of the optic nerve is also said to be imperfect in these cases.[1]

Optic nerve.—I have already described the appearance of this nerve in health, and have incidentally noticed a few of its morbid changes, such as are found in connection with myopia, and with syphilitic inflammation of the iris.

Very great variations in the form and color of the nerve are compatible with good sight. As age advances, the tissue of the nerve appears to become denser, less succulent, so as to occupy a smaller space than in early life. Its color also becomes darker, and in some old persons approaches to gray, while its outline slightly deviates from that circular form which one must assume as the standard of perfect health. Indeed, it is extraordinary to see how much variety in its size, form, and color may coexist with a fair amount of vision.

A very common appearance is that of a thin line of black pigment skirting the margin of the optic nerve to the extent of a sixth, a quarter, or the half of its circumference. Strictly speaking, we must regard this pigmentous deposit as morbid; but its existence cannot be of any great importance, inasmuch as we so frequently meet with it in eyes which, if judged by their power of vision, may be termed healthy. [A more or less pronounced "choroidal ring," or pigmented choroidal boundary, is not uncommon in perfectly healthy eyes, and can hardly be considered pathological.]

Inflammation ("optic neuritis") attacks the nerve in various forms. Sometimes it is evidenced by extreme hyperæmia, the whole disc assuming a pink or reddish color. After this redness has existed a considerable time, attended with great dimness of sight, it slowly passes off, but the nerve does not resume its healthy aspect. On the contrary, it either presents a dead-white appearance, or a dirty-gray tint; in either case the bloodvessels remain much diminished in size, and vision is almost or altogether lost.

This form of optic neuritis is occasionally met with as a result of excessive indulgence in tobacco.

That too great use of this narcotic has, in certain constitutions, a direct tendency to induce disease in the optic nerve, can no longer, I think, be doubted. I say

[1] It is almost impossible for an artist to give a correct representation of a detached retina. A very able attempt to do so, and indeed the only one I have seen which has any resemblance to nature, is in Liebreich's Atlas, tab. vii., fig. 2.

[1] Liebreich, tab. xii., fig. 5.

"in certain constitutions," for it is notorious that a vast proportion of those who smoke tobacco do so with impunity so far as sight is concerned.[1]

[There is nothing distinctive in the ophthalmoscopic appearances in tobacco amaurosis, in fact, they may be entirely negative. There may be no other symptom than a gradually progressive impairment of vision, usually proportionately greater at the macula, where it may even be complete, giving rise to a central scotoma. There is often a very perfect central scotoma for color, while the color-perception in other parts of the retina is nearly or entirely normal. The symptoms are the same as those of alcoholic amaurosis, or "amblyopia potatorum," and, indeed, the vices of excessive drinking and excessive smoking are so often found in company, that it is not easy to separate their effects. Some authors have combined them in the term "amblyopia ex abusu." The main point in treatment is *total* abstinence from tobacco or alcohol, or both, and it is usually, at least in the earlier stages, followed by complete recovery. The administration of strychnia in gradually increasing doses, hypodermically, or by the mouth, is thought by some to promote the cure. A similar impairment of vision is sometimes met with in cases of lead-poisoning; in which albuminuric retinitis may also occur from accompanying disease of the kidneys.]

Another form of neuritis either coexists with syphilitic iritis, or is liable to come on several weeks or months after all inflammatory appearances in the iris have passed away. The area of the pupil may be quite free from deposit, there may be no trace of redness in the sclerotic, and yet the sight becomes as dim as it was during the height of the iritic inflammation. In such a case the ophthalmoscope alone can enable us to form a diagnosis. The optic nerve is either wholly hidden by a filmy cloud of lymph, or its outline can be dimly traced through the cloud, which not only involves the optic disk itself, but obscures the adjacent portion of the retina. If a case of this kind is neglected, the lymph eventually forms an opaque white patch overspreading the optic nerve, and according to the amount of deposit, sight is either greatly obstructed or wholly destroyed. If the case be seen at an early stage, a careful mercurial treatment, either with or without iodides according to circumstances, may cause complete absorption of the lymph.

One of the most remarkable changes to which the optic nerve is liable, is that observed in cases of blindness from cerebral disease, involving that portion of the nerve which is contained within the cavity of the skull. In old-standing cases of this kind we find evidences of chronic congestion of the retina, and degeneration of the optic disc. The fundus presents a uniform red color, sometimes so strongly marked that no trace of separate choroidal vessels can be seen, and the vessels radiating from the centre of the nerve are almost lost in the deeply-tinted surface on which they lie. Contrasting strongly with the redness surrounding it, the optic nerve at once attracts attention by its extreme whiteness, which resembles that of ivory, rather than the creamy or faintly pinkish tint which I have described as characterizing the nervous tissue in a state of health. These dense-looking, homogeneous nerves have undergone *white atrophy*, and have lost the greater portion of their true nervous element, little more than the fibrous tissue remaining. (Plate XII., fig. 2.) The combined appearance of a red, thickened retina, and a homogeneous, white optic nerve, at once assures the practised observer that the case is beyond recovery.

[This condition is usually the result of what is called "descending neuritis," and has, therefore, been preceded by an inflammatory condition of the nerve, evidenced, in ophthalmoscopic examination, by redness or an œdematous "woolly" appearance of the disc, and indistinctness of its outline; sometimes by an accompanying retinitis. It is a not unfrequent result of cerebro-spinal meningitis. Primary "progressive atrophy" may, however, occur without a preceding stage of hyperæmia, perhaps most frequently in connection with spinal disease, particularly with locomotor ataxia.

Another form of optic neuritis of intense practical interest, not only to the ophthalmic surgeon but to the physician,

[1] My limits do not permit me to enter fully upon this most important subject, but I will mention just one case, on account of its peculiar circumstances. A literary man, of large and active brain, a voluminous writer on varied topics, came under my care for gradually diminishing reading power. He had been for years a hard worker, reading and writing many hours each day. His hobby was tobacco-smoking, which he believed to be essential to the due action of his intellectual powers, and except during the time devoted to sleep and to meals, the pipe was seldom laid aside. He wrote a history of tobacco, and held public disputations in defence of its use. He lived by his pen, and when he began to find reading and writing a little difficult, he only smoked the more. I found all the media clear, both optic nerves small and anæmic, and the retinal vessels diminished in size. He could no longer read ordinary type, and when I last saw him he was compelled to give up literary pursuits altogether.

is that known as "engorged papilla," "papillitis," or, more generally, as "choked disc." The optic papilla is swollen and prominent, and its projection into the vitreous can be measured by experienced ophthalmoscopists. It has a reddish-gray color, and a striated appearance, and is gradually merged in the surrounding retinal surfaces, its outlines being completely obliterated. The retinal arteries are contracted, and the veins engorged and tortuous, and there are frequently hemorrhagic extravasations. (Plate XII., fig. 3.) As, in the earlier stages, the process is one of congestion rather than of inflammation, and affects the connective rather than the nervous tissue, *vision may be but slightly affected.* It is important to remember that the ability to read even fine print is no proof that this condition does not exist. Later in the disease, engorged papilla may give place to atrophy. The manner of its causation has been the subject of voluminous discussions, which it would be out of place to enter upon here, but its almost invariable connection with intracranial disease is well established. It may result from pressure on the nerve in the orbit, from tumor or other cause, but in such cases is usually found in one eye only.

Choked disc gives no definite information as to the location or the exact character of the cerebral disease, but is generally a symptom of increased intracranial pressure, the result, in a large proportion of cases, of tumor. The theory of its cause which is now most generally accepted, is that fluid is forced into the space between the sheaths of the nerve from the subarachnoid spaces with which it is continuous.]

In a practical point of view there is no change in the optic nerve more important than the pitting or *excavation* which is connected with glaucoma. This appearance can be well seen only in the early stage of the disease, for after a while a change in the corneal epithelium takes place which prevents any clear view of the fundus of the eye. When the concavity of the nerve is considerable, the retinal vessels are seen to bend abruptly as they are passing over the edge of the depression. (Plate III., figs. 5 and 6). The color of the nerve is at first not much altered, but after a time it assumes a grayish tint, which, under certain conditions of illumination, appears darker than it really is. These changes will be again alluded to in the chapter on glaucoma.

Cases of greatly impaired sight are met with in which the optic nerves are found as deeply excavated or cupped as in the most advanced stage of glaucoma, while there is an absence of all the other signs of this disease; the corneæ being clear and smooth, the irides active, and the globes not harder than natural. Simple wasting (*gray atrophy*) of the nerve seems to be the cause of its concave appearance. [The excavation from atrophic shrinking is never so deep as the typical glaucomatic cup.]

Atrophy appears sometimes to affect the whole retina and optic nerve, without any previous inflammatory process. This condition is chiefly met with in old persons; it also may befall those in the middle period of life. The power of sight gradually fades away year by year, until eventually mere perception of light remains. The ophthalmoscope reveals a perfectly clear condition of the media, and at the same time affords such a complete view of the choroidal vessels, that the observer could almost fancy the retina to be altogether absent. The optic nerve is small and shrunken, irregular in its outline, and of a dark gray or drab color; and the vessels emerging from it form delicate, hair-like, red lines, barely traceable across the area of the illuminated choroid.

In some instances I have seen this extreme atrophy of the retina accompanied with a very remarkable change in the choroidal vessels, their color being pale orange or buff, instead of red.[1] This appearance I have met with only in old people; and their failure of sight has been so slow, and unattended with marked symptoms of any kind, that they have been supposed to be the subjects of steadily advancing cataract.

Treatment.—If the reader now refers back to the sketch I have given of the morbid changes in the retina and choroid, he will at once perceive how impossible it must be to lay down any rules for treatment that will be uniformly applicable to all so-called "amaurotic" cases. In a group of patients, complaining of almost the same defects of sight, one will be discovered to have a portion of the retina overspread with blood; in a second, the axis of vision will be occupied by a patch of pigment; while in a third, the retina and choroid will be partially separated by serous effusion.

Are these three patients to be treated alike? Do they, in fact, possess anything in common? And yet formerly they would all have been classed together as "amaurotic," and probably have undergone salivation accordingly.

If the ophthalmoscope had done nothing else than limit the wholesale administration of mercury in eye-diseases, it would have conferred an immense boon upon mankind.

Even when it has been ascertained that

[1] See E. Jäger, Beiträge zur Pathologie des Auges, taf. vi.

an extravasation of blood has taken place from the vessels of the retina or the choroid, the treatment will require great care and discrimination on the part of the surgeon. In one case the extravasation will have been accompanied, or immediately preceded, by giddiness and other symptoms of disordered circulation in the brain, and may have been induced by alcoholic or other stimulus, or by great muscular efforts in a plethoric and vigorous subject. Rest and abstinence may be indicated as the first preparatives for treatment. In another case, rupture of a retinal vessel may have occurred in a feeble and delicate patient, during a period of perfect repose, and may have resulted from a diseased and softened condition of the coats of the vessel itself. I have seen extravasations take place in such subjects in consequence of sudden exposure to cold, especially when the body or mind had been previously much exhausted. Here, moderate stimulants would be beneficial, and the absorption of the effused blood would be hastened by medicines of a tonic character—iron or quinine.

In all cases of extravasation of blood from the vessels of the retina, the surgeon should take care not to make unnecessary examinations with the ophthalmoscope, as each occasion of exposure to its strong light increases the congestion of the part, and consequently the liability to farther extravasation. I have known several instances of this kind, in which a fresh escape of blood immediately followed the use of the ophthalmoscope. Having once clearly made his diagnosis, the surgeon may be satisfied as to the progress of absorption by the steady improvement of the patient's sight, and may postpone any farther use of the ophthalmoscope until recovery has been well established.

Where serous effusion has taken place between the choroid and retina, in addition to other general treatment, iodine internally, combined with blistering in the neighborhood of the eye, may be tried; although, if the effusion be of old standing, and to a large amount, little, if any, benefit can be hoped for.

It must be evident that structures, like the choroid and retina, which derive their supply of blood from such remote and deep-seated sources, cannot be treated by local depletion, even if depletion were desirable. The surgeon must seek to restore the balance of the patient's circulation by general treatment, based on a careful and comprehensive survey of constitutional peculiarities and mode of life, and especially of the habits or pursuits which may be supposed to have given rise to the local changes. Inquiries must be instituted as to the existence of any of those causes which impair the sight by exhausting the patient's general nervous power. The abuse of alcohol, tobacco, or opium; venereal excesses; protracted suckling, and many other depressing agencies, will suggest themselves to the mind of the acute practitioner. He will take care not to trust too implicitly to this or that article of the pharmacopœia, and will especially be on his guard against the depressing agency of mercury—the drug which he will find lauded almost as a panacea for "amaurosis" in some of the medical works of the last generation.

Galvanism and strychnine he will frequently hear spoken of as possessing wonderful efficacy in arousing the dormant powers of the optic nerve. The action of strychnine appears so entirely limited to the motory fibres of the nervous system, that to expect it to influence a nerve of special sense is to confuse all our notions of physiology. Galvanism has been at various times a favorite remedy with the public, and its administration admits of a parade of scientific apparatus which specially imposes on the popular mind. [The treatment by strychnia has now numerous advocates of high authority, and, even in optic atrophy, has in many cases produced excellent results. It should be administered in increasing doses until the limits of toleration are reached.]

Those who believe—or make their patients believe—that they can render cataractous lenses transparent by means of galvanism, will doubtless long continue to vaunt its efficacy also in cases of the most complete disorganization of the retina.

An anatomical classification of eye-diseases—the arranging of them, that is to say, according to the changes of structure which cause the impairment of sight—has such obvious advantages that it has become almost universal among ophthalmic writers; but it has the inconvenience of offering no heading under which to place certain defects which cannot be precisely demonstrated as originating in any one part of the optic apparatus.

Of this kind are the various luminous appearances depending upon some temporary disturbance of circulation—occasional obscuration of half the field of vision (*Hemiopia*)—the condition termed *Hemeralopia*—congenital inability to distinguish certain colors—spectral illusions, etc.

Faulty perception of colors.—The following list comprises only a portion of the many terms invented to designate this affection: *achromatopsia*, *chromatopseudopsia*, *chromatometablepsia*, *chromatodysopsia*, *chromatopseudoblepsia*, *dyschromatopsia*. These words, it will be observed, all imply difficulty or inability to *see colors;* but in fact the subjects of this affection are

not insensible to all, but only to some colors, while others are seen perfectly. The term *color-blindness*, employed by Wilson,[1] is on this account objectionable. *Daltonism*[2] commemorates the faulty perception of an individual, without conveying any notion of the nature of the defect. I have suggested the word *acritochromacy*,[3] as implying "inability to discriminate between colors," which pretty nearly defines the true nature of the affection.

On investigating the reported cases of "acritochromacy," the defect appears in most instances to resolve itself into inability to perceive red; and the compound tints suggesting doubtful impressions are those into which red enters to a greater or less extent. Yellow seems to be always appreciated, and blue almost always.

The cause of the defect probably resides not in the eye itself, but in that portion of the brain to which the impressions of light are ultimately conveyed. Hitherto very few dissections have been made of the eyes of "acritochromatic" persons. Dalton had supposed a blue tint of the vitreous humor to be the cause of his own peculiarity, and, in accordance with his express wish, his eyes were examined after death, but nothing unusual was discovered.

Acritochromacy may take place as a temporary morbid symptom.

Some years ago a very intelligent and sensitive little girl, ten years old, was brought to me in consequence of almost total blindness, which had come on within the preceding four days. She was unable to guide herself, and, if left alone, could not avoid the articles of furniture in the room. She with difficulty perceived a sheet of paper lying on the floor, and, of course, was wholly unable to distinguish the largest type. She had been much excited by the emulation of a school-competition, and had taxed her memory considerably in learning by heart. Slight dilatation and sluggishness of the pupils were the only ocular symptoms; but she dreamed vividly, occasionally felt faint during the day, and had numbness and formication in the left leg and foot. I enjoined complete rest, and prescribed iron in small doses. Within a week she could trace lines of type as streaks, but was quite unable correctly to appreciate colors. She had no difficulty with yellow and blue, but mistook all tints containing red. Ten days later her general health was restored, and with a little pains she could read the type of a leading article in the Times; but her appreciation of colors was still imperfect. At the end of a few weeks all defect of sight was gone; she read the smallest type, and her power of discriminating colors was quite restored.

Wilson has insisted upon a very important practical point connected with "color-blindness," as he terms the defect, namely, that persons employed on railways and elsewhere, where colored lights are used as signals, should be previously tested as to their powers of perceiving colors with perfect accuracy. On many occasions our lives depend on the ability of some solitary signal-man to distinguish between green, the sign of safety, and red, that of danger. Now that an universal railway system has forced upon us a mode of travelling fraught with incessant peril to life and limb, we cannot afford to neglect a single chance of safety.

[Much attention has recently been given to color-blindness, particularly in reference to safety in travelling. Of many thousand males examined, in Europe and this country, about four per cent. have been found color-blind. In females the defect is comparatively very rare. This subject is fully treated in Dr. B. J. Jeffries' work on "Color-blindness; Its Dangers and its Detection."]

There seems to be no cure, or even palliation, of a defect which appears to depend upon a congenital want of appreciative power in the brain itself.

Hemeralopia—literally "day-sight"—is a term used to designate a peculiar form of intermittent blindness, the subjects of which see perfectly in broad daylight, but lose all power of perceiving objects as soon as the sun has set and twilight commences. The persons in whom the affection is most frequently met with in this country are those just returned from sea-voyages, especially from the East or West Indies. It is also frequent, I am told, among the natives of the inland parts of India, who attribute it, as our own sailors do, to sleeping exposed to the moon-beams.

The real cause of hemeralopia appears to be exhaustion of the nervous power of the retina from over-excitation by the sun's rays, so that the part is rendered incapable of appreciating the weaker stimulus of twilight or moonlight. Exposure to tropical light, however, is not the sole cause of the affection; for I have met with it in persons who had never quitted the temperate regions of the globe; but in most of these latter cases the complaint had shown itself after long voyages, which had subjected the patients to exhausting toil and exposure to severe weather, while deprived of a

[1] See Monthly Journal of Medical Science, Edinburgh, July, 1854, p. 1.

[2] From Dalton the chemist, who published his own case in the Memoirs of the Literary and Philosophical Society of Manchester, 1798, vol. v., p. 28.

[3] Ἀκριτοχρωματία.

proper supply of fresh provisions and vegetables.

In these latter cases I have commonly found that a few weeks' residence on shore, with a mixed vegetable and animal diet, and the use of quinine, has restored vision to a healthy state.

Nyctalopia—"night-sight"—would imply inability to see by daylight, the exact converse of hemeralopia. In a certain sense, patients affected with that irritable form of corneal inflammation commonly called "strumous ophthalmia," might be termed nyctalopic, so unable are they to bear strong light, and so willing to open the eyes and look about them in the dimness of twilight; but, apart from inflammation, I have never met with nyctalopia to the extent described by authors; and I am inclined to consider the affection an imaginary one, invented, as it were, to form a companion disease to the hemeralopia just described.

CHAPTER VIII.

DISEASES OF THE VITREOUS BODY.

Before the invention of the ophthalmoscope, little was known about the morbid conditions of the vitreous humor. It was frequently found to become diffluent (*synchysis*) after injuries to the eyeball, and during the progress of certain chronic inflammations; and it was assumed to play an important part in glaucoma. The ophthalmoscope presents to our view a great variety of morbid products in the humor, which it is difficult to observe with accuracy, on account of the rapidity with which many of the flakes, filaments, and corpuscles float about with every movement of the eye.

When *hemorrhage* occurs from the ciliary processes, or from the superficial vessels of the retina, a portion of the clot not unfrequently becomes entangled in the vitreous humor, and forms an irregular, filamentous, black-looking[1] body, floating to and fro across the illuminated field of the ophthalmoscope.

In *syphilitic inflammation* of the deep tissues, the vitreous humor loses its perfect transparency, and becomes turbid; and in severe cases, flakes of lymph are seen freely moving about in it, like tangled blackish threads.

A very singular phenomenon connected with the vitreous humor is that termed *sparkling synchysis* ("synchysis étincelant"), produced by the disintegration of an altered crystalline lens. This body, after becoming opaque from ordinary cataractous change, sometimes undergoes extensive fatty degeneration, crystals of cholesterine being abundantly formed within its substance. If a lens in this condition is broken up with the needle, or becomes ruptured and thrown down to the bottom of the vitreous chamber by a blow, the crystals of cholesterine are set free, and at each movement of the eye appear as innumerable brilliant points, like the finest gold-dust, sparkling in the dark area of the pupil. When the eye is kept at rest these crystals gravitate to the bottom of the mingled aqueous and vitreous humors, some sinking down behind, and some in front of the iris. [This mode of origin of synchysis scintillans must be considered, at least, extremely exceptional. Certainly it has often been met with in patients with perfectly normal lenses. Crystals of cholesterine sometimes occur after hemorrhages in the vitreous, where, it is thought, they may be deposited from the blood. Some authors attribute them to fatty degeneration in the vitreous, but their etiology is not understood.]

Sparkling synchysis is very rare, and I have not had an opportunity of examining any cases with the ophthalmoscope.

Cysticerci.—Perhaps the most striking phenomenon connected with the vitreous humor is the presence of entozoa, either freely floating within it, or protruding into it from the surface of the retina, to which they are attached. By far the greater number of cases of this kind which have been recorded are to be found in foreign journals, for hitherto only a very few have been observed in this country. I have myself never met with a case.[1]

Of twenty cases reported in various numbers of the Archiv für Ophthalmologie, the majority appear to have been under the care of Graefe. In *eight* cases the cysticercus was either embedded in the very tissue of the retina, or firmly adherent to its surface; in *six* cases, the creature appeared to be behind the retina; while

[1] I may here notice that floating bodies in the vitreous humor are not necessarily *black* because they look so under the ophthalmoscope. Any body sufficiently opaque to intercept the rays of light passing from the illuminated retina to the eye of the observer will appear black, although, if examined out of the eye, it might be found light-colored or even white.

[1] Teale gives the history of a case occurring in his own practice in 1864 (Ophth. Hosp. Reports, vol. v., p. 318). Bowman reports another (op. cit., vol. iii., p. 324). Hulke, in dissecting a disorganized and irritable eye, found a cysticercus between the choroid and retina.

in *six* others it was quite detached, and floated freely in the vitreous humor. This latter circumstance induced Graefe in two instances, to attempt its removal; in the first case, making an incision in the sclerotic and passing in a forceps through the wound; in the second, adopting a slower and more complicated proceeding. First, a portion of the iris was excised, so as to make a large artificial pupil; then, when all irritation had subsided, the lens was extracted through a flap-section of the cornea; and lastly, after a considerable interval of time had been allowed to elapse, a forceps was introduced through a fresh opening made in the cornea, and the cysticercus grasped and drawn out.[1]

From a review of all these cases, it appears almost certain that the cysticerci found loose in the vitreous humor had attained that position by perforating the retina, having been originally formed between that tissue and the choroid, in which situation it seems that all the cysticerci above described were originally developed.

In a more recent volume of the *Archiv*, Graefe gives the total result of his experience as to the occurrence of cysticercus (xii., 2, 174; 1866). During thirteen years 80,000 patients had attended his clinique, and among them rather more than 80 cases of cysticercus in the deep tissues of the eye had been observed; 3 had been seen in the anterior chamber; 5 under the conjunctiva; 1 in the substance of the lens; 1 in the orbit. The ages of the patients varied from eight years to seventy.

The very curious researches recently made into the natural history of intestinal parasites have proved that the *cysticercus telæ cellulosæ* and the *tænia* are really the same creature in different stages of development.[2]

I believe it has been well ascertained that the inhabitants of Northern Germany are more liable to tape-worm than those of the British Islands, and this circumstance would account for the fact of the cysticercus having been so much more frequently met with in the former country.

Muscæ volitantes. — The little threads and spots which, by some persons, are seen to float and glide over their field of vision, were formerly attributed very commonly to congestion of the choroid. Tyrrell, for instance, assigned as their cause "a preternatural dilatation of some of the delicate vessels" of the part. It seems strange that any one could overlook the fact that *fixed* bodies—which dilated vessels of the choroid must be—if they pressed upon the retina so as to impair its function, would suggest to the patient the idea of *fixed* spots in the field of vision, which could only appear to move when the eyeball itself was set in motion. The spots known as *muscæ volitantes*, on the contrary, change their position whenever the eye is suddenly moved; and when the eye is again fixed, the spots still continue for a time to float about in various directions, eventually appearing to descend, as if sinking in a fluid.

They are most commonly met with in short-sighted subjects, and are quite compatible with life-long continuance of the acute powers of vision which such persons frequently enjoy. They are usually first noticed between the ages of twenty and thirty; and when they have begun to attract the patient's attention, they appear rapidly to increase in number. This apparent increase is partly due to the fact that, by anxiously watching them, the patient soon acquires a habit of bringing fresh bodies into view.

If the eye be turned towards a clear sky or a bright cloud, and then kept steadily fixed, the spots appear to sink slowly downwards, just as filmy particles would sink in a liquid, which had been shaken and then allowed to rest. A sudden turn of the eye will again cause the little bodies to disperse for a moment, and when the eye is once more fixed, they slowly descend as before.

So long as the patient steadily concentrates his attention on any external object, the *muscæ* are not seen; but if he accidentally catches sight of one of them the whole field of vision at once becomes crowded with them.

The best way of examining the floating bodies is for the patient to look directly downwards upon the illuminated field of a microscope. They will then be recognized as beaded filaments, variously twisted and bent; sometimes appearing as loose knots of coiled-up fibres entangled together. When thus grouped they have a grayish color, but when a single filament is examined, it is seen to be made up of highly-refractive globules, varying in form and size. Sometimes a filament may be seen to bend, and again become nearly straight, or to turn in such a manner as to present itself in a foreshortened position. This latter circumstance proves that the bodies float freely in a fluid, and are not situated, as some have supposed,

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[1] A case of cysticercus in the vitreous humour is related by Desmarres, Traité théorique et pratique des Maladies des Yeux, 2d edit., 1858, vol. iii., p. 756. Another by Williams in the Cincinnati Lancet and Observer, May, 1858. See Liebreich's Atlas, tab. vii., figs. 5 and 6.

[2] See Küchenmeister and Von Siebold, On Animal and Vegetable Parasites (Sydenham Society, 1857).

upon the surface of the retina. This is still further proved by the fact that the blinking of the lids has no effect whatever upon the position of the *muscæ* in the field of vision. If, when the lids are closed, the eyes are turned towards a strong light — exposed to sunlight, for instance — the *muscæ* can still be seen, and their movements will be just as free as when they were observed with the eyes open.

Some interesting experiments were made on himself by Mackenzie,[1] to determine the seat of *muscæ volitantes;* but the most conclusive researches as to their nature are those by Jago,[2] who has satisfied himself that these disquieting spectres are, in fact, nothing more than the beaded filaments of the vitreous body itself. The normal network of these filaments, he says, can be seen by any one who knows how to look for them—under certain conditions, I presume, of impressibility of retina. Those filaments which, from being tangled together in irregular masses, form such annoyances to the patient, would appear to be the filamentous network in a disintegrated state.

There are few phenomena which give rise to more alarm in patients' minds than *muscæ volitantes.* A vague notion that they are the forerunners of amaurosis or cataract is almost universal; and even medical men are apt to confound these *floating muscæ* with the moving cloudy shadows resulting from effusions of blood or lymph within the vitreous humor, or with the fixed spots betokening that some limited portion of the retina has become insensible to light. A careful attention to the appearances of the *muscæ volituntes,* as I have described them, will enable the patient to convince himself of their real nature; and the surgeon may console him with the assurance that, although incurable, they are perfectly compatible with excellent and enduring sight.

It is to be hoped that medical men in general will speedily arrive at this conviction; for it is lamentable to meet with patients who have gone through years of treatment, often of the severest kind—even to bleeding and salivation—or at best through an equally ineffectual course of tonics and local applications, and after all have remained with their *muscæ* undiminished, and their minds still burdened with anxiety and fears of approaching blindness.

Appearances so common as floating *muscæ* will of course be observed by multitudes of persons who subsequently may become the subjects of either retinal disease or cataract. All I mean to insist upon is, that the *muscæ* and the diseases of retina or lens have no causal relation to each other.

[1] First in the Edinburgh Med. and Surg. Journal for 1865; and again in his Practical Treatise, etc., 1854, p. 951.

[2] Entoptics, with its uses in Physiology and Medicine, 1864, p. 93.

CHAPTER IX.

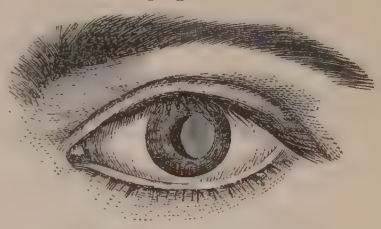
DISEASES OF THE LENS AND CAPSULE.

In a state of health the lens and the membranous capsule inclosing it are perfectly transparent. In early life they are also quite colorless; but after the age of thirty the lens in most persons begins to assume a pale-yellow tinge; and this gradually becomes more marked as age advances, until in old subjects it frequently acquires the color of amber.

Any loss of transparency in the lens, whether affecting the whole or only a portion of it, constitutes *cataract;* and in strictness this term should be limited to changes in the lens and its capsule. To call an opaque inflammatory effusion in the area of the pupil a "spurious cataract," is to introduce a loose and uncertain terminology, which can only give rise to confusion in our descriptions of disease.

Abnormal position of the lens.— The "suspensory ligament," which is attached to the capsule all round the margin of the lens, maintains it in a fixed position. A blow on the eye sometimes ruptures a portion of this ligament, and allows the lens to become tilted backwards.

[Fig. 267.



Dislocation of the lens (Wells).]

If the ligament is detached to a considerable extent, the lens sways to and fro with every movement of the globe, and vision is much confused. Eventually, under such conditions, the lens becomes opaque; but I have seen cases in which it remained transparent for a very considerable time.

It appears that the suspensory ligament is liable to a congenital defect, whereby the lens, instead of maintaining its normal position, undergoes displacement in

a lateral direction, so that its centre no longer coincides with the centre of the pupil. A curious instance of this malposition of the lens occurred in a mother and three children who came under my care. In the mother, and in one of the sons, both lenses were displaced upwards and inwards; in another son, directly inwards; and in the third, directly upwards. In none of these cases did the lenses deviate, or only in the slightest possible degree, from their normal transparency.[1] [Complete dislocation of the lens may also occur, either backwards into the vitreous, or forwards into the anterior chamber.]

Cataract.

This term, as I have already observed, should be strictly limited to denote partial or complete opacity of the lens.

The existence of capsular cataract has of late years been called in question, and I shall presently notice the grounds of this new opinion.

Opacities of the lens do not appear to be all of precisely the same nature. Some depend upon a shrinking and wasting of the fibres themselves, without any appreciable change in their chemical composition, while the more strongly-marked and chalky-looking streaks and spots are formed by new deposits of earthy and fatty material.

We shall best appreciate the changes which take place in cataract by glancing at the anatomy of the lens. It is completely inclosed within the very thin, but strong, capsule, which is throughout perfectly transparent and homogeneous. To this capsule is attached the "suspensory ligament of the lens," which passes off from the back of the ciliary processes to be implanted into the capsule of the lens, with which it becomes identified. Immediately within the capsule is a layer of cells; internally to this layer are arranged the superficial fibres of the lens, softer and of a more fragile consistence than those forming the centre or *nucleus*. The fibres of the lens are disposed in planes, the exact arrangement of which cannot easily be understood without the aid of diagrams; it may suffice for our purpose, however, to state, in general terms, that the fibres form radii converging from the circumference to the centre, and are more curved as they are nearer to the anterior and posterior surfaces of the lens, and less curved as they approach its vertical plane.

Such being the manner in which the elements of the lens are arranged, we shall at once perceive the reason why the opacities of cataract present such different appearances, accordingly as they are in the superficial cellular, or the deeper fibrous layers.

When the superficial cells and adjacent soft fibres of the lens become disintegrated, and broken up, and intermixed with generally diffused earthy deposits, the whole area of the pupil presents a milky appearance, without any regular striæ being visible. If the softening process has been going on for a long time, there is usually an abundant formation of fatty matter, and the faintly-bluish skim-milk color gives place to a slightly-yellow tint, like that of cream.

If, however, the cataractous opacity commences in the unbroken fibres of the lens forming its cortical portion, whitish streaks are seen converging from the circumference towards the centre. In persons past middle life some of these streaks have a slightly-yellow cast, while others are perfectly white. This difference of tint depends upon the fact I have already noticed, namely, that the body of the lens, after the age of thirty or forty, acquires a yellow tinge; and consequently, although the opaque streaks are in themselves white, only those appear so which are on the anterior face of the lens, and are viewed through the colorless media of the cornea and aqueous humor; while, on the contrary, the streaks on the posterior face of the lens, being seen through its still transparent, although yellowish, body, acquire a corresponding change of color. A practised eye will also recognize a difference of form between these two sets of striæ; those on the front of the lens presenting a convexity, and those on the hinder face a concavity, towards the plane of the iris.

These striæ can be clearly seen only in the earlier stages of cataract, for eventually the superficial fibres and cells become broken up and disintegrated, and then the lens presents one uniform whitish or grayish surface.

The fibres of which the *nucleus* consists are denser and firmer than those constituting the cortical portion; but they are disposed in the same radiating form. When this nucleus becomes opaque in old age, it does not present the marked striæ so characteristic of *cortical* cataract, but assumes a more uniformly cloudy appearance. The distinction between the *cortical* and the *nuclear* portions of the lens are best seen in the common form of congenital cataract, in which the whole nucleus is opaque, while the periphery remains almost or quite transparent.

I have briefly alluded to the doubts

[1] See a description of these cases in Ophthalmic Hospital Reports, vol. i., p. 54, 1858; also in my Guide to the Practical Study of Diseases of the Eye, 2d edit., p. 401.

which some histologists have thrown upon the existence of "capsular cataract"—a term employed even quite recently as designating one of the two grand divisions of cataractous opacities. These doubts chiefly originated with Stellwag,[1] who, after carefully examining with the microscope about fifty cataracts with apparently opaque capsules, asserted that in every instance the opacity was caused by substances *attached to* the lenticular surface of the capsules, but not *deposited in* the very tissue of the capsules themselves. The opaque material which, to the naked eye, seems identified with their tissue, chiefly consisted of earthy and fatty deposits, firmly adherent to it, but yet separable by mechanical or chemical means.

The marbled and mottled appearance commonly described as characterizing "capsulo-lenticular cataract" is said by Stellwag to depend upon the irregular manner in which the earthy and fatty material is deposited on the inner surface of the capsule.

Although the facts pointed out by Stellwag and others may justify us in discarding the term "capsular" as designating a species of cataract, it would be affectedly precise to abandon the term *opaque* as applied to a portion of capsule impeding vision, merely because the opacity may be due to earthy or fatty matter adhering to the membrane. And, indeed, a portion of capsule which is transparent and visible when perfectly tense, will become opaque when relaxed and thrown into folds.

Reverting to the changes in the lens itself, I would observe that a very common error exists with regard to the use of the terms *hard* and *soft* as applied to cataract. These terms are employed as if, in certain cases a softening process set in from the very first, whilst in other cases the reverse took place, and the whole lens underwent a steady process of hardening. But if we examine a healthy lens at the infant period of life, and compare it with one which is congenitally opaque, we shall find but little difference in the consistency of the two structures. In the adult, the lens retains nearly its normal consistency so long as the opacity remains at the striated stage, and it is not until after a considerable period that the superficial portion of the lens undergoes that process of disintegration which imparts to it the uniformly whitish and milky appearance.

Again, in old subjects the commencement of cataract is not attended with any marked hardening of the lens, although, as the nucleus becomes opaque, its fibres appear to undergo a certain process of drying and atrophy. But even in the oldest persons superficial softening eventually sets in, usually many years after the commencement of opaque striæ.

Hence it will appear that the terms *hard* and *soft* express only a certain stage in the progress of a cataract; that in no form of the disease does the lens from the very beginning undergo progressive hardening; but those lenses which for a long time retain their normal firmness while opacity is advancing eventually becomes softened, and may even, in the lapse of many years, undergo a complete transformation into a fluid condition.

Under the two heads, *Nuclear* and *Cortical*, we may arrange all the various forms of cataract; abolishing the old term "capsular cataract," and assigning those opacities which were formally known by that name to the *cortical* division.

Nuclear cataract would comprise, first, the congenital form of the disease; and, secondly, that which is met with in old age, either alone, or, more frequently, associated with marginal striæ.

Cortical cataract is by far the more usual form; for the opacity which occurs in middle life almost invariably commences in the cortical portion of the lens; and even in old age this is the rule, the rare exception being that the nucleus becomes cloudy before marginal striæ are developed.

It was owing to insufficient exploration of the eye that the reverse of this was formerly believed to be the case; but no one can have had extensive opportunities of examining the eyes of old persons under the influence of atropine, without convincing himself that, even in extreme old age, it is much more common to find marginal opacity beginning whilst the nucleus is still clear, than to find nuclear opacity beginning while the margin of the lens is transparent.

Diagnosis of cataract.—There is no better test of an ophthalmic surgeon's skill than his ability to determine the presence or absence of opacity in the lens. And nothing is more important to be precisely ascertained; for the want of skill to detect cataract in an early stage may lead the surgeon to regard the case as one of retinal defect; or, on the other hand, he may mistake the reflex of light from the retina for the opacity of cataract.

I will not detain the reader with a long account of the *subjective* symptoms which attend cataract; for the detection of the disease depends wholly upon a careful examination of parts lying open to our observation. A full detail of subjective symptoms is, no doubt, very useful in ascertaining the morbid condition of a structure wholly concealed from our view; but this is not the case with the lens, and if

[1] Die Ophthalmologie, 1853–58.

we expect opacity to exist, we have simply to look for it.

A more or less marked dimness of sight, uniformly involving the field of vision—coming on gradually, and without inflammation, unattended with any impairment of motory power in the iris—such would be the symptoms which would make us suspect the existence of cataract. Our examination should be conducted in the following way:—

The patient should be placed close to a window admitting bright daylight—not direct sunlight—and care should be taken that the light does not fall upon the cornea from more than one window, and that reflections from mirrors and other polished surfaces do not interfere with the single ray which should pass into the pupil. A convex glass of an inch focus should be used as a condenser, to concentrate light upon the surface of the patient's lens, while we explore it with the naked eye. In this manner faint streaks of opacity may be detected, which would otherwise escape us. Each eye must be separately examined.

We must never rest satisfied with a patient's assurance that he can or cannot read, but must obtain a precise standard of his sight by making him read aloud from type of different sizes.

In hospital practice, those who have not learnt their letters may be told to count dots, point out a single or a double line, an asterisk, and other typographical marks.

All these experiments must be made while the eye is in its natural state. We next proceed to dilate the pupil with atropine. A solution of two grains to the ounce of distilled water is usually strong enough for this purpose, and care should be taken to obtain the sulphate perfectly neutral. Any excess of acid makes the application painful, and so of course does the addition of alcohol, which I have sometimes seen prescribed. The lower lid should be slightly drawn away from the globe, and a few drops of the solution let fall between them; and then the lids should be kept closed for a quarter of an hour or half an hour. Children, and even timid adults, are often alarmed at the sight of any bottle of drops, so instinctively do they suspect that all drops necessarily cause pain. A disc of atropized gelatine may be quietly slipped on to the conjunctival surface of the lower lid, without the patient being aware that any such application has been made.

When the pupil is fully dilated, we repeat our examination as before, with the aid of concentrated daylight, carefully illuminating and exploring the extreme margin of the lens, and, if its body be sufficiently transparent, lighting up and examining its posterior surface. In this manner the faintest streaks of commencing cataract may usually be detected; while dense patches along the margin of the lens, opaque striæ converging along its anterior or posterior surface, delicate lines radiating from the centre, or the uniform haze of a cloudy nucleus, can hardly escape detection.

While cataract is still in a very early stage of development, it is so important to ascertain the condition of the retina and choroid, that in every case the ophthalmoscope should be used to complete our diagnosis.

By examining the deep tissues we sometimes detect in them morbid conditions, which would induce us eventually, when cataract had become complete, to abstain from operating; or, if an operation were deemed desirable, it would be undertaken on the full understanding that only partial success would be attainable.

Reasoning *à priori*, we should imagine that the ophthalmoscope would be an infallible means of detecting those faint traces of cataractous opacity which elude the ordinary modes of observation; but experience shows us that, under the strong glare of the ophthalmoscope, these faint opacities frequently disappear, just as a slight flaw in a piece of glass might become visible when laid upon a black surface, although it would not be seen when the glass was held in front of a brilliant light.

In most cases, however, the opaque striæ of a commencing cataract are seen under the ophthalmoscope as radiating black lines, while a hazy nucleus assumes the appearance of a dark cloud in the centre of the pupil.

Sometimes the very earliest commencement of cataract may be detected by examining the lens with the naked eye in a darkened room, while a strong light is thrown upon the part either from the ophthalmoscopic mirror, or by means of a convex glass of a short focus. This oblique illumination will often reveal highly-refractive globules and radiating lines throughout the whole extent of a lens, which to ordinary ophthalmoscopic examination seemed transparent.

[The usual, and most convenient, method of examination, is by artificial light, using one of the object glasses of the ophthalmoscope to converge a cone of light obliquely upon the lens, and the other as a magnifier. The slightest commencing opacity will not escape detection in this way, but care must be taken not to mistake for a sign of cataract the increased reflex from the lens, due to the physiological increase in its density in old

age. The latter will not cause any marked dimness of the fundus on ophthalmoscopic examination.]

I have already spoken of the twofold division of cataractous opacities into cortical and nuclear, accordingly as they are situated in the periphery or the centre of the lens. To give any special names to cataracts, in consequence of the various shapes which the opaque deposits assume, appears to be altogether trifling and useless. It is evident that the transparent and opaque elements of a diseased lens may arrange themselves in such a manner as to produce infinite variations of shades and figures, without offering any real variety in their composition. There are, however, a few leading peculiarities connected with age and mode of development, which demand a separate notice.

CONGENITAL CATARACT.

This opacity may exist in very different degrees.

1. The slightest form is that of a small white central dot on the anterior face of the lens (*Cataracta centralis*). This dot consists of a minute portion of earthy matter deposited in the most superficial portion of the lens, just within the capsule. In cases of this kind the rest of the lens commonly remains throughout life transparent, and the patient is often unconscious of any defect of vision. Occasionally, however, a few faint white lines are seen radiating from the central dot. If the rest of the lens remains transparent, this slight form of cataract should by no means be treated by operation.

2. Sometimes, instead of forming a minute central dot, the earthy deposit is so large as to occupy nearly the whole area of the pupil, when in its contracted state. The deposit projects forwards in the shape of an obtuse white cone, and appears to adhere by its base to the anterior surface of the capsule. This, however, is not really the case, the cretaceous mass being embedded in the superficial portion of the lens, and covered by the transparent capsule. The term *Cataracta pyramidata* has been given to this congenital form.

3. The most common kind of congenital cataract is that in which the nucleus is opaque, while the peripheral portion remains transparent. In the contracted condition of the pupil this transparent portion is hidden by the iris, but it comes into view when the pupil is widely dilated. In the contracted, or but slightly dilated, state of the pupil, its entire area is occupied by a grayish-white opacity, made up of fine radiating lines, which converge to an opaque white patch at the centre of the lens. When the pupil is widely dilated with atropine, this opacity is seen to be surrounded by a perfectly black area, and through this clear ring-shaped space the patient has tolerably clear vision. Those who examine such cases for the first time are apt to imagine that the opaque nucleus which they see really constitutes the whole lens, shrunken and contracted to an unnaturally small size, and that the dark ring-shaped space is altogether unoccupied by lens-tissue. Occasionally a few white lines are seen to traverse this space, passing from the opaque nucleus to the outer margin of the lens. When such a nuclear cataract is broken up with the needle, in the operation for solution, the real nature of the case is made manifest, and the peripheral portion of the lens soon becomes as opaque as the nucleus itself.

If cases of this kind are not operated upon in early life, the patients, although very short-sighted, continue for many years to enjoy considerable powers of vision; but usually, towards the age of forty, if not sooner, the peripheral portion of the lens undergoes a change, and gradually becomes opaque.

4. A form of congenital cataract, much more rare than that just described, consists of a very faintly-striated opacity of the nucleus, unaccompanied by that chalky-white central patch which renders the ordinary congenital cataract so conspicuous and so easy of diagnosis. Several instances have come under my notice, in which this rarer kind of cataract has remained undiscovered until the patients were of an age to be sent to school, when their inability to read ordinary type has caused their friends to seek advice.

5. It is very unusual to find cataract first commencing between infancy and puberty; but I have met with a few cases in which the opacity seemed to have begun when the patients were about nine or ten years old. They had been sent to school at the age of seven or eight, and had readily learned to read; but at the end of a year or two their sight began to fail, they became at first short-sighted, and then gradually lost the power of reading any but large type, or of recognizing faces across a room.

I have observed two distinct forms of opacity in these cases.

In one form the lens was dotted throughout with minute white points, arranged in the course of its fibres. These dots were as small as if pricked-in with the finest needle, and the general effect they produced was that of a very faint haziness in the pupil, only recognizable under concentrated light.

In a second set of cases the opacity was wholly confined to the posterior surface of

the lens. In some instances there was one isolated patch in that situation, not exactly in the axis of the lens, but reaching from near that point to its extreme edge. In other cases the whole posterior face was covered with very fine opaque lines, closely set together, and converging from the circumference to the centre, so as to produce the effect of a delicate fibrous membrane of concave form. Encircling the exact centre of this opaque surface was a whitish ring, more dense and earthy in appearance than the rest of the striated surface of which it formed a part.

These opacities, limited to the posterior face of the lens, of course require for their detection far more careful observation than congenital cataract of the ordinary kind, in which the whole nucleus is opaque, and the centre probably marked with a chalky-white patch in the very centre of the pupil.

Congenital cataract, whatever form it may assume, is frequently accompanied by a rhythmical twitching movement of the eyeballs, the effect of irregular action either of the recti or the oblique muscles. This twitching is known by the name of *nystagmus*. It does not, however, invariably accompany congenital cataract, some patients suffering from this affection being entirely free from any irregular muscular action: while, on the other hand, *nystagmus* is met with in many cases of defective sight wholly unattended by any opacity of the lens.

There are certain morbid deposits in the deep tissues of the eyeball which in infants and children may be mistaken for the opacity of cataract. Scrofulous and encephaloid deposit, for instance, in their early stage, are not unfrequently mistaken in this manner; but a careful examination through a well dilated pupil, cannot fail to detect the real nature of the disease. Both scrofulous and encephaloid deposits have a more or less yellow color, and by a practised observer will be recognized as lying much farther back than the hinder surface of the lens. At a certain stage, however, of scrofulous and encephaloid deposit the lens becomes cloudy; and how, it may be asked, is a secondary cataract of this kind to be distinguished from one which is primary, and unconnected with any other affection of the globe? In an eye affected with simple cataract the position of the iris is usually vertical, or nearly so; the pupil is active; the lenticular opacity is regularly striated, and perhaps exhibits also at its centre a white dot. In advanced scrofulous and encephaloid disease, on the contrary, the anterior chamber is obliterated, the pupil is irregular, dilated, and fixed; the lens has an uniformly cloudy appearance, and sometimes receives from the mass behind it a somewhat yellowish tint. Congenital cataract, too, almost invariably affects both eyes; while encephaloid deposit almost as invariably occurs in one eye only. Scrofulous deposit does, indeed, occasionally affect both, but rarely to the same extent, or at the same time.

In children and also in older persons who have been brought under my notice for congenital cataract, I have been struck with the frequent occurrence of diseased teeth; the incisors and canines being dwarfed, deficient in enamel, discolored and honey-combed on their anterior surface, and their cutting edge worn away and blunt. I am unable to offer any explanation of this condition of the teeth, which I do not find mentioned by any ophthalmic observer.

CATARACT IN ADULTS.

Except as a result of injury, cataract is rarely seen to commence between puberty and the middle period of life. Up to the age of forty it is a rare disease, it becomes more common in patients who have passed their fortieth year, but it is after the age of fifty or sixty that we are more especially on the watch for it in patients complaining of failing sight.

Even up to extreme old age cataract usually commences at the circumference of the lens, in the form of opaque striæ, which gradually advance along the anterior and posterior faces of the lens towards its axis.

About the same time very fine whitish lines may be observed to radiate from the anterior pole of the lens, marking the divisions which exist between the planes in which its fibres are arranged. After the age of sixty a hazy condition of the nucleus is commonly found co-existing with advanced marginal opacity; but even in extreme old age it is far more common, as I have already observed, for cataract to commence at the margin than at the nucleus.

If we trace the rise and progress of cataract in an elderly person, the changes will usually be found to occur in the following order. First, opaque striæ are formed at the extreme edge of the lens, and commonly it is the lower edge which is thus affected. These striæ gradually coalesce into patches, and then spread themselves over the posterior face of the lens, only a few extending a short distance over the anterior face. At this point of development the cataract may remain stationary for a year, or even for several years. Then a further change takes place, and the whole body of the lens, but especially the nucleus, becomes slightly hazy,

but not so as to prevent the posterior radiated opacity from being recognized when properly illuminated. The opaque striæ on the anterior face of the lens gradually advances until their tips appear within the area of the pupil. The haziness of the body of the lens increases until even concentrated light fails to reveal the posterior striæ, and at last only the anterior surface of the lens can be seen. At this stage of cataract, vision is restricted to mere perception of direct light, or of that reflected from white or polished surfaces. Perhaps bright colors may still be recognized.

Up to this point the fibrous structure of the lens can still be traced; but as years go on, its surface becomes more opaque and whiter in consequence of disintegration of the superficial fibres, and the deposit among them of earthy and fatty material. Occasionally crystals of cholesterine, just within the capsule, may be recognized by their peculiar sparkling appearance.

It sometimes happens that this final stage of superficial softening does not occur, and the cataract is then very difficult of detection, having a dull brownish appearance like horn.

A very rare form of lenticular opacity is that termed "black cataract." The name is frequently given to lenses which are only of a dark-brown color, but absolute blackness is sometimes met with. It must not, however, be supposed that in these cases the blackness of the pupil is like that presented by a healthy eye, in which all the humors are perfectly clear. In the two or three cases of black cataract which I have seen, there was not the slightest doubt as to the existence of a cataract, although the blackness, so remarkable after extraction, was not suspected; for, in each instance, several fine whitish lines could be seen radiating on the anterior surface of the lens, formed, no doubt, by slight earthy deposits just within the capsule.

Fluid cataract; Morgagnian cataract.—The softening process, which begins in the superficial portion of an opaque lens, may go on until, in the course of years, the whole mass becomes converted into a thin pulp. The nucleus, for a long time, resists this softening change, and a lens consisting of a firm nucleus, surrounded by a turbid pulp of disintegrated tissue, has received the name of "Morgagnian cataract."[1]

As in fluid cataract all the superficial portion of the lens is disintegrated, there is of course no trace of those radiating striæ so characteristic of ordinary opacity. Sometimes a fluid cataract is bluish-white, like milk-and-water; in other cases it assumes a dirty-gray color, or a pale-yellow tint, like that of cream. Its consistence appears unequal, as if some portions were coagulated, and others perfectly fluid.

The creamy color is usually found in cataracts that have existed in the fluid state for a considerable time, and it seems rather paradoxical to assert that it is very difficult, even for a practised observer, to distinguish between a fluid lens of this kind and one which has undergone a change of a directly opposite character, and become solidified by earthy deposit. The perfectly fluid and the perfectly solid lens are equally devoid of fibrous markings, and the inequality of consistence in the former presents an appearance very similar to that resulting in the latter from the variety in tint, caused by the manner in which the earthy constituents of the solidified lens are deposited on the capsule.

The following are mentioned among the distinguishing signs of a fluid cataract—an advance of the iris towards the cornea, caused by an increase in the bulk of the lens, attending the fluid change—and a difference in the degree of opacity in the cataract, as respects its upper and lower portions, caused by the gravitation of its denser particles. But neither of these signs can be relied upon; for in cases of fluid cataract it often happens that the iris deviates little, if at all, from a vertical plane; and the separation of the contents of the capsule into fluid and solid is seldom sufficiently complete to allow of the more solid portions gravitating in the manner described by authors.

If a fluid cataract is examined with

[1] This form of cataract was not described by the Italian anatomist from whose name the term is derived. In dissecting the eyes of animals he had observed a fluid to exude from between the capsule and the lens, and concluded that this fluid always existed during life. In compliment to the discoverer it was termed by anatomists *liquor Morgagni*, and its existence in the living eye was for a long time regarded as indisputable; subsequent observation, however, has proved it to be a product of post-mortem decomposition. Morgagni has been, as it were, quoted against himself; for, in treating of the causes of cataract, he suggests that the disease may originate in a deficiency of this very fluid, whereby the lens, he thinks, would become dry and opaque. His words are: "Tunicâ in vitulis etiam, bobusque, sive recens sive non ita recens, perforatâ, pluries animadverti illico humorem quendam aqueum prodire: quod et in homine observare visus sum, atque adeo credidi *hujus humoris secretione prohibitâ*, crystallinum siccum et opacum fieri, fere ut in extracto exsiccatoque crystallino contingit." (Adversaria Anatomica, etc., Lugd. Bat., 1741, Adv. vi., p. 90.)

the microscope, the lens-fibres are found in every stage of disintegration, mixed up with earthy matter and a multitude of oil-globules.

TRAUMATIC CATARACT.

The lens may lose its transparency in consequence of a blow on the eye, although the globe may not be ruptured, or the lens itself displaced from its connections; the mere shock being sometimes sufficient to affect the nutrition of the lens, and induce a gradual opacity of its whole substance.

Any penetrating wound of the lens is sure to produce cataract, and if the wound in the capsule remains open, so as to allow the superficial cells and fibres of the lens to imbibe the aqueous humor, the whole mass gradually becomes disintegrated and absorbed, so that eventually a wounded lens may wholly disappear without any surgical interference. It was a knowledge of this natural process that first suggested the operation for the cure of cataract by *solution*. It is only in exceptional cases that the whole lens becomes absorbed in consequence of a wound. More commonly it happens that a certain portion of lens-tissue remains inclosed within the capsule, and undergoes fatty change. The following is the appearance such a traumatic cataract would present some years after the occurrence of the injury.

There is probably some adhesion of the pupillary margin to the capsule, the result of old iritis; the pupil is occupied by a disc, formed by the approximation of the anterior and posterior surfaces of the capsule, inclosing between them some remains of very opaque lens-tissue. This disc is situated much farther back than the position occupied by a full-sized lens, and its dead-white patchy area not unfrequently exhibits some glistening crystals of cholesterine.

In cases where the wound of the lens has been followed by a considerable amount of iritis, the whole margin of the pupil may be found adherent to the anterior capsule, which may also be coated with a dense membrane, composed of old lymph. The pupillary area may be small, and not susceptible of increase by the use of atropine, on account of the intimate union between the iris and the capsule. Occasionally there is a deceptive appearance of a partial opening of the pupil, and a casual or inexperienced observer will suppose that a sufficient portion of the pupil is free, so as to allow of useful vision. The supposed aperture, however, is really a patch of black pigment, lying on the whitish membrane which is closing up the pupil. Light, concentrated on the part by means of a lens, will almost always reveal the true nature of the supposed aperture, or, should this means fail, the ophthalmoscope will at once resolve the doubt.

It would be impossible to describe all the various appearances presented by the pupil after the partial or complete absorption of a wounded lens. The capsule may block up the entire space in the manner just described; it may form a delicate filmy net-work, hardly visible except under concentrated light; it may have been completely torn through at its centre, the peripheral portion retracting all round, so as to form a white ring, almost hidden by the iris; or it may assume the appearance of a single white band stretched across the pupil from side to side. In short, there is hardly any possible variety of figure which the opaque capsule may not assume.

It never undergoes absorption, but it often appears to do so, in consequence of the manner in which it retracts and shrinks together when divided. This retractile property of the capsule should always be borne in mind by the surgeon, in the various delicate operations which become necessary when an opaque portion of it is obstructing the pupil. He should take care not to isolate any part of the opaque membrane, but to regulate his incisions and lacerations of it in such a manner that it may always have a fixed point at the periphery, towards which it may retract, and so leave the central portion of the pupil free.

Dislocation of the lens into the anterior chamber.—This accident takes place as a result of external violence, such as a blow upon the eyeball or a violent fall. It more frequently happens when the lens has been long in an opaque condition, and its suspensory ligament weakened, or partially detached by disease. The appearance of an opaque lens in the anterior chamber is so peculiar, that the nature of the accident can hardly be mistaken. When the lens is dislocated in a transparent state, its margin presents the appearance of a ring of golden light. Pain and inflammation set in very soon after the occurrence of the accident, and loss of the eye can be averted only by prompt removal of the lens, through a suitable opening in the cornea.

I have already spoken of certain forms of partial displacement of the lens, when treating of the inflammation such accidents give rise to (see the section, "Traumatic Iritis," p. 86); and have considered "subconjunctival dislocation of the lens" in the chapter on Affections of the Sclerotic (p. 83).

TREATMENT OF CATARACT.

Before describing the treatment of cataract, I may be expected to say something respecting the morbid agencies which give origin to it. But, in truth, the causes of cataract, whether remote or proximate, have hitherto received no satisfactory explanation. The fact that the lens may be opaque at birth, or may become so in old age, at once proves under what widely different conditions the disease is developed; and we need but cast a glance at the varying and even opposite theories which have been given as to the predisposing causes of cataract, to convince ourselves they are but guesses, for the most part fanciful and unfounded.

Thus, one author thinks that persons exposed to the heat and glare of strong fires are predisposed to cataract; another makes the same remark of those who drink sour wines; by a third, the prevalence of cataract among the Turks is attributed to their using opium; while other observers consider that the inhabitants of volcanic countries are peculiarly liable to the disease. Certainly, in its senile form, cataract is common enough among our own agricultural laborers, who know nothing of sour wine, and very little of opium, are not incommoded by over-large fires, and never saw a volcano.

The truth seems to be, that, in all countries, cataract is a frequent accompaniment of advancing years; and neither social position nor peculiarity of employment exempts the aged from being liable to it.

Can cataract be cured without an operation? This question will be answered in the affirmative by hosts of quacks, who, for their own selfish ends, avail themselves of that shrinking from anything bearing the name of an operation, which is a natural instinct in us all, and pretend, by means of liniments, or drops, or a still more scientific-looking galvanic battery, to turn opaque lenses into clear ones.

It would be presumptuous and absurd to pronounce absolutely that no cure for cataract, short of a surgical operation, can *ever* become possible. But certainly nothing approaching to such a cure has hitherto been discovered.

The surgeon must constantly be on his guard against being too much impressed with the mere existence of opacity in the lens, as if it were altogether an independent disease.

Various inflammatory conditions of the eyeball may eventually produce cataract, but in such cases there are usually some signs of disease in other tissues, as well as certain peculiarities in the position or appearance of the lens itself. Old adhesions between the pupillary margin and the anterior capsule—a bulging forward against the cornea of the iris and lens, or their receding too far backwards, so as to produce an unnaturally large anterior chamber—an irregularly dilated and fixed pupil—a tremulousness of the lens whenever the recti muscles are put in action—total loss of perception of light—such are the more striking conditions which at once would lead us to institute searching inquiries into the earlier history of the case, or to regard the cataract as unsuited for operation.

It must always be remembered that simple opacity of the lens, however far advanced, never deprives a patient of perception of light, provided the retina is sound. Indeed, in the great majority of instances, a patient with no other disease in the eye but an opaque lens, will not only readily perceive the shadow of a hand or other object passing between him and the sky, but, with his back to the window, will perceive the light reflected from a sheet of paper, although he may be quite unable to detect the form of the reflecting surface. Many patients, with densely opaque lenses, will, in the same position, recognize well illuminated colored surfaces, such as bright red or yellow, or will even discriminate between yellow and white. If in addition to this perceptive power, the iris maintains its vertical plane, the pupil is round and active, the cornea brilliant, the consistency and movements of the globe perfect, the surgeon may regard the cataract as suitable for operative treatment.

Long experience and observation will give to the surgeon a certain empirical tact in determining whether a given case of cataract is, or is not, fitted for operation. He recognizes at once the difference between an eye which has passed through inflammatory stages, and one in which simple opacity of the lens is present. In the latter case, however dense the cataract may be, the patient has a certain expression of *trying to see*, quite different from the manner of one who merely turns his eyes this way or that, at the command of the surgeon.

In all cases the pupil should be dilated with atropine before the surgeon finally resolves to operate, so that no concealed adhesion between the iris and the capsule may remain undetected.

[A point of great practical importance to be decided before extracting, is whether the cataract is fully formed, or "mature." The risks of the operation are greatly increased if there is clear, soft cortical matter to be scraped off in the passage of the lens through the wound. On account of its transparency it cannot be removed, and afterwards becomes opaque and

swells. It may interfere with the healing of the incision, or set up destructive iritis, or, if those dangers are escaped, may cause a dense and tough secondary cataract by uniting with the capsule.]

OPERATIONS FOR CATARACT.

These may be arranged under three heads: *depression*, *solution*, and *extraction*.

1. In *depression*, or "couching," as it was formerly termed, the lens is thrust from its natural position in such a manner that, although still within the eye, it may allow the rays of light to pass unimpeded through the pupil to the retina.

2. The operation by *solution* or *absorption* grew out of that by depression; for it was found that if, in the attempt to depress the lens, it accidentally became much broken up, the fragments gradually dissolved and disappeared; and hence it occurred to certain thoughtful observers that this absorbent power in the system might be taken advantage of in such a manner as to avoid the dangers inseparable from the old operation of "couching." Hence arose *discission* or *division* of the lens, since modified into the operation by "solution."

3. In *extraction* the opaque lens is removed bodily out of the eye, through a wound made for that purpose in the cornea.

OPERATIONS BY DISPLACEMENT OF THE LENS.

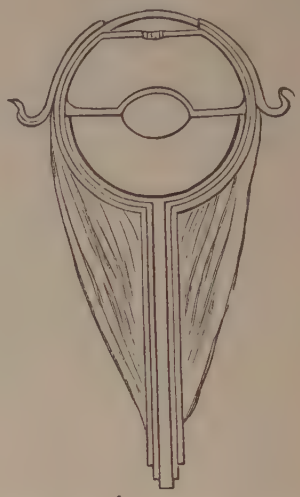
(*Depression; Reclination.*)

Those who are interested in the early history of ophthalmic surgery will find the older descriptions of cataract, and the operation for its cure, wholly unintelligible, unless they are acquainted with the views of the ancients respecting the anatomy of the eye.

Even so late as the time of Vesalius it was believed that the lens occupied the exact centre of the globe, and it is so figured in that anatomist's work, De Corporis Humani Fabricâ, 1555, p. 798, where it is placed exactly midway between the iris and the junction of the optic nerve with the retina; the posterior chamber of the aqueous humor and the chamber of the vitreous humor being precisely of the same extent. Such a position of the parts would of course afford ample space for an opaque *humor* to collect, and form the supposed "cataract" between the lens and the iris.

It is a curious fact that, while the operation of "couching," or depression, had been practised from very early times, each successive generation of surgeons firmly maintained that what they depressed was not the lens—which, indeed, they believed to be the immediate seat of vision—but a skin or coagulated film, in

Fig. 268.



Section of the eye as figured by Vesalius.

front of it. Ambroise Paré, the most celebrated surgeon of his day, after describing the mode of introducing the needle through the sclerotic, and depressing the cataract, adds, "en faisant telle chose se faut bien donner garde de toucher à l'humeur cristalin, pource que, comme nous avons dit, il est le principal instrument de la veüe."[1]

It was not until the latter part of the seventeenth century that the real nature of cataract was understood; and some of the old oculists, who had passed their lives in depressing lenses without knowing it, were furious at the new-fangled theory of cataract being the opaque lens itself.[2]

The early surgeons, therefore, who, from time immemorial, had taught the operation of depression, however they may have erred in *practice*, through their ignorance of the real pathology of cataract, acted in perfect accordance with their own *theory* of its nature; for such a membrane as they believed a cataract to be, when once thrust fairly away from the pupil, would not have been likely to set

[1] La Méthode curative des Playes, etc., Paris, 1561.

[2] Thus Woolhouse, an oculist who, in spite of his gross ignorance, was the leading operator of his day, was most indignant when Brisseau, appealing, in proof of his assertion, to dissections of cataractous eyes, declared the lens to be the seat of cataract. Facts were against Woolhouse;—"tant pis pour les faits!"

up irritation. One can less readily understand how, after the real nature of cataract had become known, operators could still imitate the old manipulations, and persuade themselves that so bulky a body as the lens could be displaced in such a manner that it should not press upon, or interfere with, any of the delicate tissues surrounding it.

To pass a needle through the sclerotic, until its point arrived at the upper edge, or the front surface of the opaque lens, which was then thrust downwards, or backwards and downwards, and imbedded in the vitreous humor, appeared a real triumph of surgical skill; so instantaneous was the benefit conferred by the operation, and so trifling the pain of its performance. The patient was in a moment restored to sight, and the smallness of the wound seemed to obviate all risk of inflammation. And, no doubt, depression, or the modified form of it, termed reclination, in which the lens is turned over on its posterior face, instead of being thrust vertically downwards, would be a very perfect operation, if it were possible to insure the lens being conducted to the position so neatly figured in diagrams, where it reposes in the vitreous humor, quite out of the way of the pupil, and close to, but never touching, the retina or ciliary processes.

But how is the lens to be so placed in reality? Even if the whole eyeball were as transparent as the cornea, so that the surgeon could keep the point of his needle in view throughout every stage of the operation, how could he deposit the lens precisely in the position I have mentioned? Or, if he succeeded in leaving it in the very spot he had intended, below the pupil, and yet above the retina, how could he insure its remaining there? how prevent its sinking downwards, so as to come in contact with the retina, or falling forwards against the ciliary processes and iris, where it must act as a foreign body, and set up irritation which nothing could subdue?

Depression, the oldest form of operation by displacement, was performed in the following manner. The patient was seated, and the surgeon sat facing him. An assistant, standing behind the patient, steadied the head and raised the upper lid. The needle being thrust through the sclerotic, a little below the equator of the eye, and a short distance from the edge of the cornea, was to be carried between the iris and lens, until the point of the instrument appeared in the area of the pupil. It was thrust on as far as the upper part of the lens, which was then pressed directly downwards, until it descended below the ordinary level of the pupil. It must be evident to any one familiar with the anatomy of the eye, that a body so large as the lens could not be made to descend vertically to any considerable extent, without coming in contact with the ciliary processes; but we must remember that the old oculists performed their operations without the aid of mydriatics, so that they could press the cataract out of sight without forcing it to descend so low as would be necessary to make it disappear from an artificially dilated pupil. Still, there can be no doubt that they frequently thrust the opaque lens either against the ciliary processes or against the retina, and hence the "inflammation," which was looked upon as almost a natural consequence of the operation.

To obviate the danger consequent upon depressing the lens directly downwards, the operation of *reclination* was devised, whereby the lens was pressed in a direction backwards, downwards, and a little outwards. The needle was passed on until its lance-shaped head appeared in the area of the pupil, as in the operation of depression; but the flat of the instrument was placed on the anterior face of the lens, a little above its middle, and steadily pressed against it, until the lens was forced to quit its natural position, and sink down into the vitreous humor. Here it was to be left, with its anterior surface directed upwards, its posterior surface downwards; close to, but not touching, the retina; its lower edge towards, but not in contact with, the ciliary processes; a state of things often figured in diagrams, but rarely, I should think, effected in practice.

The close approximation of the pupillary margin to the anterior capsule of the lens must render it almost impossible to pass an instrument between the two structures without wounding either one or the other of them. In fact, the capsule is usually opened, and undergoes still farther rupture in the attempt to dislodge the lens. No doubt this accidental rupture of the capsule and lens would, in some degree, obviate the dangers of the operation, inasmuch as a lens thus partially broken up would have some chance of undergoing absorption, which would not take place if the lens, according to the idea of the operation, were displaced still inclosed in its unbroken capsule.

If chronic change should have occurred in the suspensory ligament of the lens, the cataract inclosed in its unbroken capsule might sink at the first touch of the needle, especially if the vitreous humor had become unnaturally diffluent; but if no such changes should have taken place, the vitreous humor would offer great re-

sistance to this reclination of the lens; and, accordingly, various plans were suggested for facilitating the reclination by certain preliminary manœuvres. It was proposed, for instance, as soon as the needle had pierced the coats of the eyeball and entered the vitreous chamber, to carry the point to the back of the lens, for the purpose of lacerating the posterior capsule; then the point was to be carried round to the anterior capsule, which was to be lacerated in a similar manner, and it was not till after this preparation that the surgeon was to displace the lens itself.

Other operators, finding that the elasticity of the healthy vitreous humor was an obstacle to the passage of the lens through it, suggested that the needle should first be passed to the spot where the lens was finally to be lodged, and that a bed should there be prepared for it by the disintegration and breaking up of the cells of the vitreous humor; and to this bed the lens was finally to be conducted by the needle applied to its anterior surface.

Descriptions of all these manœuvres read very well; but to carry them into effect is a very different matter. It must be remembered that while the point of the needle is lacerating the posterior capsule, or making a soft place in the vitreous to receive the lens, the instrument is wholly concealed from the surgeon's view, and is within a few lines of the most delicate and important structures. What risk must there not be that, while endeavoring to break up the cells of the vitreous, or lacerate the capsule of the lens, the surgeon may all the while be tearing up the ciliary processes, or even the retina itself!

To evade the difficulty of displacing a cataract by mere pressure with the flat of the needle, some operators proposed that, instead of carrying the instrument between the iris and the anterior capsule, its point should be thrust fairly into the substance of the lens, which would then be easily displaced, and carried downwards and outwards into the vitreous humor; the needle being disengaged by rotating it. Two difficulties, however, must attend this operation—the risk of driving the lens before the instrument in the attempt at transfixion, and of pressing the lens against the retina in endeavoring to disengage the point of the needle.

But even supposing that the surgeon succeeds perfectly in accomplishing the object he has proposed to himself, and, by depression or reclination, modified by any of the methods I have described, has displaced the cataract from the axis of vision, and sunk it in the vitreous humor, without inflicting injury either on the ciliary processes or the retina—what has he done? He has deposited a large foreign body—for as such we must regard a cataractous lens detached from its organic connections—in close proximity to the retina. How can he insure the foreign body's remaining suspended in the vitreous humor, without coming in contact with surrounding parts? Will not the vitreous cells in the immediate neighborhood of the cataract undergo gradual disintegration, and allow it to come into contact with the retina, or fall forwards against the iris?

No doubt these would have been the almost invariable results of depression and reclination, were it not that, in the attempts to displace the lens, it very commonly became a good deal broken up; and this very accident it was which predisposed the lens, after it had been displaced, to undergo absorption. The ultimate issue, however, of most operations of displacement was sufficiently bad to justify my assertion, that it is essentially an unscientific and rough proceeding, calculated to set up a chronic state of inflammation in the deep tissues of the eye, which is in its very nature uncontrollable, inasmuch as the exciting cause, the displaced lens itself, cannot be removed.

Inexperienced persons who witnessed an operation of displacement were apt to admire the rapidity and apparent ease with which it was performed, and the immediate restoration of sight which took place; and they contrasted it, perhaps, with the extensive wound made in extraction, the accidents that occasionally attended that operation, and the slow after-progress towards useful vision. But these appearances were deceptive; every bystander could see the difficulties and mishaps that attended extraction, but in depression or reclination, if only the cataract disappeared from the pupil, everything seemed to have succeeded. The damage inflicted on deep-seated parts could not be detected, and it was only in following up the case that their result became appreciated, in the slow and insidious changes within the globe, which, many months after the operation, terminated in utter loss of sight. In such cases it was said how well the operation succeeded—how perfectly the patient saw, till, unfortunately, inflammation set in, and, in spite of everything being done that medical skill could suggest, destroyed the sight. And why did "inflammation set in"? Either because structures essential to vision had been injured by some stab in the dark during the operation, or because a foreign body had been left in contact with them, to set up in due time an uncontrollable process of disorganization.

OPERATION BY SOLUTION OR ABSORPTION.

I have said that this operation grew out of that by depression; and it is only surprising that some of the older surgeons, who had been struck by the manner in which fragments of the lens, accidentally detached during their attempts at depression, became spontaneously absorbed, did not discover that this law of absorption might be applied to the removal of the whole lens.[1]

When this law began to be understood, surgeons fell into the mistake of supposing that the more completely the lens was broken up at first, the quicker would absorption go on; and they therefore endeavored to cut up the whole lens into fragments, by what was termed the operation of *discission*.

The cure of cataract by solution is one of the most perfect and beautiful within the range of surgery. It is based on the law, already alluded to, that if the capsule be lacerated so as to expose the tissue of the lens itself to the macerating influence of the aqueous humor, the cells and fibres of the lens, by gradually imbibing this fluid, become broken up and dissolved; and are then so completely absorbed, that at the end of a period varying in duration according to the consistence of the lens and the absorbent power of the patient, every vestige of cataract will have disappeared. In fact, provided the patient's constitution be vigorous, and the lens be not too freely broken up at any one time, it is quite possible to effect the absorption of a cataract in an old person, even up to the age of seventy. But, inasmuch as in such persons cataract usually advances simultaneously in both eyes, the slow process of absorption is found to be wearisome and inconvenient, and liable to be interrupted by slight inflammatory attacks; and as the operation requires to be frequently repeated, the more rapid cure by extraction is to be preferred.

The leading principle to be observed in all operations for the solution of a cataract, is, not to oppress the eye with more broken-up lens-tissue than the absorbing power of the organ is capable of rapidly removing. If this rule be neglected, the numerous fragments act as so many foreign bodies; inflammation is set up in the iris and cornea, and then all absorption is at once arrested. The conjunctiva and sclerotic become injected; there is pain in and around the eyeball, with intolerance of light and lacrymation; the aqueous humor is turbid, and the epithelial surface of the cornea dull and uneven.

Operation on Infants.—The breaking up

[1] Thus Pott, writing in 1775 on the subject of depression, says: "When the opaque crystalline is in a state of dissolution, or the cataract is what is called perfectly soft, if the capsula of it be freely wounded by the couching-needle, the contents will immediately issue forth, and mixing with the aqueous humour will render it more or less turbid; sometimes so much so as to conceal the point of the needle and the iris of the eye from the operator. . . . The aqueous humour, however turbid it may become, will in a very short space of time be again perfectly clear; and if no disorder of the capsula of the crystalline, previous or consequential, prevents, the rays of light will pass without obstruction through the pupil, and the patient will be restored to as perfect vision as could have followed the most successful operation of either, or of any kind, in the same subject and under the same circumstances." He adds: "I have sometimes, when I have found the cataract to be of the mixed kind, not attempted depression, but have contented myself with a free laceration of the capsula; and having turned the needle round and round between my finger and thumb, within the body of the crystalline, have left all the parts in their natural situation; in which cases, I have hardly ever known them to fail of dissolving so entirely as not to leave the smallest vestige of a cataract." (Chirurgical Observations, etc., 8vo., 1775.)

Pott's merit did not consist in being the first to observe that soft cataracts, if broken up, would wholly dissolve, but in turning an accident into a ground for a special and definite operation; thus establishing solution as a legitimate method of removing an opaque lens. Peter Kennedy, in his anonymous Ophthalmographia, 1713, relates how, having depressed a cataract in a woman aged twenty, he endeavored a year later to do the same with the other cataract, which was of the "curdly kind." He adds: "I had no sooner touched it with the needle, when it broke, and mixed with the aqueous humour, which becoming *drumly*, the patient could no longer see; I then withdrew the needle, and began to doubt of the success, but I found in a month's time all settled to the bottom, and her sight became clear and well."

But similar cures by solution had been quite unintentionally performed nearly two centuries before the time of Kennedy; as the real seat of cataract, however, was at that period unknown, these accidental cures by solution led to no further improvement.

I have not seen quoted on this subject the following remarkable passage from Ambroise Paré: "Aucunes cataractes en les voulant abatre deviennent comme lait ou eau trouble, à raison qu'elles ne sent encore assez dures; et que telle chose advienne encore y a il esperance de guarison, pour ce que puis apres elle ne se peut rassembler, et apres quelque temps l'œil se clarifie, principalement aux jeunes."—La méthode curative des Playes, etc. Paris, 1561, p. 239.

of the lens, if carefully performed, is so devoid of danger that it should by no means be deferred on account of the tender age of the child; on the contrary, by operating early there is a greater probability of obviating those twitching movements of the globes (*nystagmus*), which so frequently attend congenital cataract. Of course, if the infant were extremely puny and ailing, affected with diarrhœa, or in any way weakened by temporary derangement of health, the operation should be deferred for a while, until the absorbent power had been restored; but it is desirable not to wait until the irritation of teething sets in.[1]

The needle I prefer for most of the operations on the lens has a small lance-shaped head, and the relative proportions of the head and the shaft of the instrument should be exactly such as will allow of the shaft playing with perfect freedom in the aperture which the head has made. If these proportions are not accurately preserved, and the shaft is made larger, with the view of preventing the escape of the aqueous humor, it becomes wedged in the wound, and all movements of the point are difficult and constrained. A needle of a larger size than that used for the ordinary operation on infants is very useful in breaking up the capsular obstructions which remain after the lens-tissue has become absorbed, as the head may be of such a size as to allow of its convex edges being made to cut.

All cataract operations are best performed on patients lying down. It was, I believe, at the Moorfields Hospital that this position was first adopted for all such operations, and it has since been introduced upon the Continent, where, a few years ago, patients always underwent the operation for cataract in a sitting posture. Infants are best secured by swathing them from the chin to the feet in a round towel. An assistant steadies the head by placing a hand on each side of it; the lids are kept apart with a spring speculum, and sometimes it becomes necessary for a little fold of the conjunctiva, just beneath the cornea, to be nipped up in a forceps, so as to steady the eye. If the operator contents himself with using a single needle he can himself with the other hand use the forceps; but if he prefers a more complete laceration of the lens by the use of two needles at once, he must of course intrust the forceps to the hands of a second assistant. [The operation is made much easier for the surgeon as well as for the patient, by etherization.]

And here I may observe, that the rule I have mentioned, as so important to bear in mind—namely, to avoid attempting too much at the first operation for solution, admits of an exception in the case of congenital cataract in *infants*. During the first few months of life the lens is so soft in texture—it so readily imbibes the aqueous humor, and undergoes dissolution, and the absorbent power is so active—that the lens may be freely torn up in every direction without the same risk of iritis and other inflammation, as would attend a similar disintegration of it in an older child or an adult. During the operation for solution on an infant I have frequently seen the entire lens shell out of its capsule, and slip forwards into the anterior chamber, without any inflammation taking place, the lacerated lens speedily undergoing complete absorption.

Previous to any needle-operations for cataract, the pupils should be dilated with a few drops of solution of atropine, applied an hour or so before.

The needle is to be introduced through the cornea[1] close to its junction with the sclerotic, and carried on until its point reaches the centre of the pupil. Then the anterior capsule is to be freely lacerated in various directions, and the body of the lens broken up, and the needle may be carefully passed quite through it, so as to lacerate the posterior capsule.

If two needles are used together, the first should be passed in until its point reaches the middle of the pupil, before the second one is introduced through the cornea.

In an infant with congenital cataract both eyes may be operated upon at once; but in an adult the worse eye, if there be any difference, should be operated on first, so as to leave the patient one partially useful eye, while the process of solution, with the temporary loss of sight which it involves, is going on.

[1] The merit of Saunders seems to have been limited to establishing *as a rule* that congenital cataract should be operated on in early infancy. No doubt this rule is a most important one; but the extravagant praise on that account claimed for Saunders by his partial friends strikes one, at this distance of time, as quite disproportionate; and his practice of keeping the operation a secret, or at least of excluding medical men from witnessing it, would in the present day be reprobated as illiberal. One pupil, Adams (afterwards Sir William), was set apart, almost with the solemnity of a consecration, as the suffragan of Saunders, but of course the operation very soon became the common property of the profession.

[1] I am assuming that all operations for solution of the lens, and for removal of capsule, are to be performed by *keratonyxis*. Formerly the needle was always passed through the sclerotic (*scleronyxis*); but the operation through the cornea, allowing, as it does, the point of the instrument being always kept in view, is evidently to be preferred.

After the operation both eyes should be kept closed by means of a light bandage, or strips of plaster on the eyelids, for twenty-four hours, by which time the little wounds in the cornea will have closed.

If the lens has been effectually broken up, and the infant is in good health, a few weeks will sometimes suffice to insure the absorption of the entire cataract; and the capsule, gradually retracting towards the periphery, will ultimately form a white ring almost or altogether concealed by the iris when the pupil is contracted.

But it is not always possible to effect this complete dispersion of the cataract by a single operation, and the capsule, inclosing between its layers a certain amount of unabsorbed lens-tissue, remains as a chalky-white disc, blocking up the pupil and preventing all useful sight. In such cases the two needles must again be employed, and the central portion of the opaque membrane torn through to the desired extent; or, in some cases, it may even be necessary to introduce the canula-forceps through an opening made in the cornea, and extract the capsule entire. This latter proceeding, however, should never be resorted to if a good central opening can be effected by means of the needles only; for in spite of every precaution, the pupillary edge frequently becomes adherent to the wound made for the introduction of the forceps; or else the traction of the iris, to which the capsule often adheres, causes subsequent distortion and deformity of the pupil.

Operation on children and adults.—The cataracts which come before us in children, and in persons under thirty years of age, are very commonly those of the congenital form, which have been overlooked during the period of infancy. For it is rare to meet with instances in which cataract *begins* to be developed in childhood, or in the early years of adult life. The operation for the solution of cataracts of this kind is the same as that I have just described on the infant, with this important exception—that in the older subjects we must take care not to set up irritation in the eye by too extensively breaking up the lens at first; least of all must we be indifferent to the risk attending the accidental displacement of the lens into the anterior chamber, an occurrence which, as I have said, may happen in the infant without any bad results.

In the first operation on an adult, the surgeon should not do more than freely break up the anterior capsule to an extent equal to the area of the pupil when not under the forced dilatation of atropine, and disintegrate the superficial portion of the lens, without disturbing the nucleus. This may be done with a single needle, the spring speculum being used or not, according to circumstances. When aided by a skilful assistant, the surgeon may often dispense with the speculum; but it is usually more convenient to employ it, and its use will enable the surgeon to perform the operation alone, if no assistant is at hand.

In using the needle, the surgeon is always to begin to act with the point upon the central portion of the lens; and in all subsequent operations he is to work from the centre, endeavoring to effect an opening in this situation quite through the lens and posterior capsule, leaving a ring-like portion of both, to be dealt with, if necessary, by a final operation with two needles.

If instead of beginning to attack the lens at the centre, the surgeon uses the needle at random, and breaks up the lens at the circumference, he will probably set loose some portions of capsule, which will afterwards wave to and fro in the pupil, and be a most serious impediment to the final success of the case.

After the operation both eyes must be kept closed for twenty-four hours, at the end of which time the needle-wound is usually united, and the aqueous chamber refilled. From the second day it will only be necessary to close the operated eye, and after a few days a shade may be substituted, and then that may be laid aside for a pair of tinted glasses. The day after the operation atropine should be reapplied, and its use continued so long as any sclerotic zone remains, or so long as the swollen and macerated lens threatens to press upon the iris. Day by day the white flocculent lens-tissue continues to pass through the opening in the capsule; and if the pupil is not kept well dilated, so as to make room for the increasing bulk of the lens, the iris will become inflamed, and pain will be set up in the eye. [The risk is lessened, especially if the pupil does not dilate freely, by a broad iridectomy done several weeks before the discission.]

No absolute rule can be laid down as to how often and at what intervals it will be necessary to repeat the needle-operation. In exceptional cases I have known a single operation suffice for the total absorption of the lens even in an adult: and in a healthy infant, after completely breaking up the lenses, I have seen both of them wholly absorbed at the end of two months. More commonly, it is necessary in children and young persons to repeat the disintegration of the lens a second time, at an interval of some months after the first operation, and a finishing touch with the needle may subsequently be required thoroughly to clear the pupil from capsule. It is important not to be premature in performing this final operation on the capsule, for during the process of absorption it undergoes so many changes of

position by shrinking, that time should be allowed for it to settle into its permanent position before the final laceration of it is made.

If, from peculiar circumstances, it be thought advisable to procure the solution of the lens in an elderly person, or in one whose power of absorption is very feeble —or in a case where the lens is of that peculiar waxy consistence which renders it so little disposed to imbibe the aqueous fluid, and become loosened up and flocculent, the surgeon must be prepared to use the needle more frequently ; for, in these instances, solution proceeds at a very slow rate, only just the quantity of lens-tissue which is crumbled off at the time of the operation being absorbed, and then no advance being made until a fresh portion of the lens is dug out.

Under these conditions, it may be necessary to employ the needle every two months ; and if slight attacks of inflammation occur to interrupt the process of absorption, even longer intervals must be allowed, so that a twelvemonth or more may elapse before a perfectly clear aperture through the centre of the lens is obtained.

In an adult it sometimes happens that, either on account of the lens being too much broken up at once, or in consequence of the absorbing power having been checked by inflammation, the eye becomes oppressed by the displaced fragments of lens ; the sclerotic and conjunctiva then become injected, there is intolerance of light and profuse lacrymation, the iris becomes discolored, the aqueous humor turbid, the cornea hazy and uneven on its epithelial surface. When these symptoms set in, the eye will be lost by chronic inflammation, unless it be forthwith relieved from the pressure of the swollen lens. The lids being separated with the spring speculum, and the globe steadied with a forceps, an incision is to be made in the cornea close to its margin, and through this a small scoop or spatula is to be introduced into the anterior chamber. The softer pulpy portion of the lens will then escape along the groove of the scoop, or by the side of the spatula when it is rotated ; and if this operation has been resorted to in time, an eye which had presented all the phenomena just described may be speedily restored to a healthy state, and that portion of the lens which has been left *in situ* will steadily undergo complete solution.

When a perfectly *fluid cataract*, or one which has to a very great extent undergone the fluid change, is operated on with the needle, it almost invariably happens that distressing nausea and violent vomiting set in immediately; and in some cases I have known this state of sickness, attended with intense neuralgia, to continue for twenty-four or thirty-six hours. As soon as the capsule is punctured with the needle, a puff of creamy fluid takes place into the anterior chamber, and a farther escape of this fluid conceals the iris from view. If nothing farther is done, the distressing sickness is almost sure to set in ; but if the surgeon gently withdraws his needle, and immediately introduces at the same spot a broad cutting-needle, or the point of a cataract-knife, and rotates the blade, the whole of the milky fluid is evacuated, and the sickness is wholly or to a great extent averted. The nausea is best combated by allowing the patient frequently to swallow small fragments of ice ; and the neuralgia in the ophthalmic division of the fifth nerve will probably yield to the application of chloroform liniment, applied by means of lint to the forehead and temple.

Operations on opaque capsule.—It sometimes happens that, in breaking up a cataract with the needle, the anterior and posterior portions of the capsule are so effectually lacerated, that they retract sufficiently to leave the area of the pupil unobstructed ; but these are exceptional cases, and usually, after the lens-tissue has been wholly absorbed, there remain some portions of opaque capsule, which must be removed before the cure can be considered complete.

Capsular obstructions are likewise met with after extraction of the lens ; and it seems desirable, therefore, to defer the consideration of them until the operations of extraction have been described.

OPERATIONS OF EXTRACTION.

The solution and absorption of a cataract in an old person is an extremely slow process, partly on account of the density and impermeability of the nucleus of the lens, and partly in consequence of the diminished activity in the interchange of material which characterizes the tissues of the body in old age.

A more rapid removal of the opaque lens, therefore, becomes desirable ; and although special circumstances may induce the surgeon to employ the operation for solution in patients above forty, or even fifty years of age, he will find it preferable, in the majority of instances, to have recourse to extraction.

Until within the last few years, the term "Extraction," had but one meaning—the removal of a cataract through a flap wound of the cornea. But in 1855 Graefe re-introduced and modified, under the name of "Linear Extraction," an operation which had first been devised by

Gibson in 1811, and at a later period he invented an entirely new operation in which, after removing a portion of iris, he drew out the cataract with a scoop.[1]

Fig. 269.

Graefe's scoop.

This scoop, first invented by Graefe in 1857, was modified by one of his assistants, and on the strength of this mere change in the shape of the instrument the whole procedure itself became universally known, not as Graefe's—which it undoubtedly was—but as Schuft's operation.[2] Other surgeons in Germany have modified Graefe's invention in various ways, but their operations are all substantially the same in principle as that which he originally devised.

We may group the various forms of extraction under three heads :—*Flap-Extraction*, *Rectilinear-Extraction*, and *Scoop-Extraction*.

FLAP EXTRACTION.

This operation, as now practised, cannot be said to have originated with any one surgeon, but has been gradually perfected from a very rude beginning. Daviel has the credit of having performed it for the first time during the earlier half of the eighteenth century ; and he professed to have derived the first hint of the operation from his countryman Petit, who, in 1708, had made an opening in the cornea to give exit to a dislocated lens. But Daviel's clumsy and complicated proceeding can only be regarded as a very rough approximation to the delicate operations of the present day. He first, with a lancet, punctured the cornea near its lower edge ; then he enlarged the wound with a narrow knife, blunt at the end, but cutting on each side ; and, lastly, completed his incision with scissors. Other surgeons simplified the operation by making the section with a knife only ; they continued, however, to do this at the lower part of the cornea, a situation very unfavorable for quick union, inasmuch as the edge of the corneal flap was liable to catch against the lower tarsus, and so become displaced. B. Bell seems to have been one of the first to suggest the practicability of the upward section ; but it is difficult to say by whom this great improvement in the operation was really established. It seems to have made its way by slow degrees, commending itself to several independent operators by its evident superiority.

It is to Beer that we owe, if not the invention, at least the systematic introduction, of the knife which still bears his name, and has superseded all other instruments in making the corneal section. This, however, Beer continued to make in a downward direction.

But it was not exclusively, or chiefly, by means of improved instruments, or by greater skill in using them, that increased success in the operation of extraction was to be attained.

The astounding plan of after-treatment which so long prevailed, and the remains of which still linger among us, makes us wonder, not that so many eyes were formerly lost after extraction, but that any were saved. Low diet, carried to the verge of starvation—profuse bleeding, both general and local—active purging and mercurialization, and long confinement to dark rooms—formed a course of discipline by which surgeons hoped to heal a wound inflicted on a structure devoid of blood-vessels, and peculiarly liable, therefore to slough or ulcerate whenever its vitality was lowered by any exhausting agencies. These surgeons saw the cornea die in persons worn out with scarlet-fever, erysipelas, smallpox, or typhus ; and yet, in the after-treatment of extraction, they seemed bent upon reducing the patient as near as possible to the same condition as those diseases would have done.

I shall have occasion hereafter to speak of the after-treatment of cases of extraction ; at present we have to consider the operation itself.

The objects to be kept in view are the following :—

To make a crescentic opening in the cornea sufficiently large to afford an easy exit to the lens. To make the incision at such a distance from the sclerotic as to insure both edges of the wound being wholly of corneal tissue : for wounds of the true cornea, provided their edges are in perfect apposition, have a peculiar readiness to unite—a property not equally shared by that extreme marginal portion of the cornea which blends with the sclerotic. [It is now generally thought that wounds heal more readily and are less liable to slough in the corneo-sclerotic junction than in the true corneal tissue.] Freely to lacerate the anterior capsule, so as to allow of the lens readily slipping through the rent when pressure is made on the globe. Lastly, to apply this pressure in such a manner that the lens may be made slowly to turn on its transverse axis, and thus to present its upper margin first at the pupil, and then at the corneal wound.

[1] The woodcut is copied from a scoop made for Graefe in 1857.

[2] Schuft changed his name to Waldau.

If we reflect, that the surgeon's object is to dislodge and press out the lens at the same time that he avoids pressing out any portion of the vitreous body, it must be evident that extreme care and delicate handling are necessary. The pressure must be regulated with a nicety which is hardly possible unless the operator has the eyeball under his sole management. The best position for the patient, therefore, is to lie upon a high couch, with his head alone slightly raised. The surgeon, standing or sitting behind him, can then control the movements both of the upper lid and of the eyeball. Formerly the patient was always seated on a chair, the surgeon sitting opposite to him, while an assistant steadied the patient's head, and raised the upper lid. But in this way it was impossible for the patient's head to be fixed as immovably as if it were resting on a couch; nor could an assistant, however careful, regulate the pressure he made on the eyeball in exact accordance with that exerted upon it by the operator.

The chief difficulty attending the formation of a proper section through the cornea arises from the fact that the knife has to be carried across a chamber filled with a fluid, ready to escape at the smallest opening which the blade of the instrument may leave unguarded; while the instant such an escape takes place, the elasticity of the contents of the eyeball forces the iris forwards over the edge of the instrument. The sawing motion we employ in using a scalpel, or any other kind of surgical knife, would be inadmissible in making a section of the cornea, inasmuch as each to-and-fro movement of the blade would allow a fresh escape of aqueous humor, or would inflict a wound on the iris, when that structure had come forward to fill up the place of the lost fluid. Hence arose the necessity for a blade regularly increasing in width and thickness from the point to the heel. Such an instrument, if steadily carried on in one direction, without any rotation, completes the wound at a single thrust, while its wedge-like form prevents the premature escape of the aqueous humor, and so lessens the danger of wounding the iris.

It would be very unprofitable to enter into a description of the various cataract-knives which at different times have been invented. One operator after another has endeavored, by alterations in the shape of the blade, to overcome the special difficulty which has most beset him; but surgeons are now pretty generally agreed that the instrument which goes by the name of Beer's[1] knife is, with certain modifications, the most useful, and that no merely mechanical contrivance can obviate all the difficulties attending the operation of extraction.

At the time when Beer wrote, and, indeed, long afterwards, the flap was always made at the lower part of the cornea; but the upper section has been found to possess such advantages, that the lower one has completely fallen into disuse.

The patient being placed in the manner described, the surgeon standing or sitting behind him, raises the upper lid, placing his fingers against the very edge of the tarsus, so as to prevent eversion. An assistant draws the lower lid downwards, and keeps it fixed by making pressure against the malar bone. He must take especial care to do this, and not in the slightest degree to press upon the eyeball. The surgeon may control its movements by allowing the tip of one finger lightly to touch the sclerotic just above the cornea, while the other rests, as lightly, against the inner side of the globe. To do this safely requires the greatest tact and care; for, as soon as the knife has transfixed both sides of the cornea, all pressure must cease, and it ought at no time to be greater than will just suffice to enable the surgeon to make his puncture and counter-puncture with certainty. Firm pressure, kept up till the section is completed, will almost inevitably cause the lens to be violently ejected, with a gush of vitreous humor.

The point of the knife is to be introduced on the equator of the cornea, a short distance in front of its junction with the sclerotic, carried steadily across the anterior chamber, and brought out at the corresponding spot near the inner margin of the cornea. During this thrust the edge is directed towards the upper margin of the cornea, so that, when the section is completed, a semi-lunar flap results.

The surgeon must take care to give the knife a steady onward pressure, so that the blade may constantly fill up the wound it is making. If he in the least withdraws the knife or rotates it, or if he at-

[1] It seems that both Casamata and Barth had employed a knife of the same shape as Beer's, but larger. Casamata's knife, if correctly figured by Wenzel (Manuel de l'Oculiste, 1808), resembled Beer's in shape, although there might be some slight difference of size. Beer insists, with amusing earnestness, upon the absolute necessity of the knife being made precisely according to his pattern —so many lines long and so many broad; if people pretend to operate in his way, and yet deviate from the exact pattern he has laid before them, he will not hold himself responsible for the consequences. (Lehre von den Augenkrankheiten, 1817, vol. ii., p. xlvi.)

tempts too soon to cut out, instead of thrusting straight on, a jet of aqueous humor takes place at that portion of the wound which is no longer filled by the blade, and then the iris instantly folds over the edge—one of the most troublesome occurrences that can attend the operation. The utmost care, however, will not always avail to prevent the loss of aqueous humor; for so ready is the fluid to spurt out, that, if the sides of the knife be unevenly ground, sufficient space may exist between the blade and the edges of the wound to allow of the escape.

If the iris has fairly come over the edge of the knife, the surgeon may disengage it by drawing the point of one finger over the cornea, from below upwards, and then making a little pressure directly backwards. In this way the iris may be made to slip back behind the edge, and by keeping up careful pressure until the section is nearly completed, the iris may be prevented from coming forward again. It is not possible precisely to describe this manœuvre for disengaging the iris; the pressure employed should be extremely delicate and guarded, and should be wholly taken off before the very last portion of cornea is divided.

The operator may find it impossible wholly to disengage the iris from the knife, and a portion of the upper margin of the pupil may be cut away. This of course causes a slight bleeding into the anterior chamber, which obscures a view of the parts during the next stage of the operation, but the lens usually escapes readily through the artificially enlarged pupil, and, except the deformity, no permanent bad result necessarily follows the accident. Sometimes, however, it happens that a *fold* of the iris is cut through, so that there results a hole in the iris just above the true pupil. When this occurs, the surgeon must at once divide the strip of iris between the two apertures, so as to lay them into one before he proceeds to lacerate the capsule.

As soon as the corneal flap has been completed, the upper lid is allowed gently to fall, care being taken that it does not catch against the edge of the flap and evert it; and the surgeon proceeds to the second stage of the operation—the division of the anterior capsule.

After a short pause, he again carefully raises the upper lid, without making pressure on the globe, and surveys the wound. If he has made it too small, he must at once enlarge it, by passing a short, narrow, blunt-ended knife, or the blade of a pair of scissors, under the flap, to the outer angle of the wound, and carefully dividing the cornea close along its margin, in a downward direction.

This enlargement of the original wound is always very difficult, on account of the unresisting state of the loose flap of cornea, and the irritability of the eye, which the surgeon dares not then control by pressure, for fear of prematurely displacing the lens. An able assistant, who can be trusted not to press upon the globe, may often render good service in this difficulty, by nipping up in a forceps a fold of conjunctiva, just below the cornea. Scissors curved on the edges will be found preferable to the knife for enlarging the wound. No difficulty should deter the surgeon from making the wound sufficiently large before attempting to press out the lens; for if, while the opening in the cornea is too small, pressure be made on the globe, the hyaloid membrane will probably give way, and allow a portion of the vitreous humor to escape; and immediately the lens, instead of presenting itself at the section, sinks down into the space left by the lost humor.

When this occurs, the surgeon must at once desist from all pressure on the globe, and pass in a fine sharp hook through the now gaping wound, and through the pupil, to the hinder surface of the lens, which must be drawn out as quickly and as lightly as possible. Sometimes it is better to pass in a flat scoop instead of the hook [some surgeons prefer a delicate wire loop, bent like a vectis]; but, whichever instrument is employed, it must be placed *behind* the lens, which is to be kept well pressed against the cornea, otherwise it will be driven still deeper into the vitreous humor.

If the surgeon has satisfied himself that the corneal wound is sufficiently large to allow of the easy exit of the lens—and for this purpose it ought to involve nearly half the circumference of the cornea—he next proceeds to lacerate the anterior capsule. The curved needle[1] is slipped under the corneal flap, care being taken not to entangle the point in the iris; and when its curve is fairly in the pupil, the handle is rotated so as to bring its point against the capsule. Some writers give very precise rules as to the manner in which the capsule is to be divided. One

[1] By a curious misnomer, this needle is commonly termed in England the "curette." The mistake arose from an accidental circumstance. The instrument for lacerating the capsule was originally called by the French *cystitome;* the scoop, attributed to Daviel, was called *curette.* It was found convenient to mount these two instruments on the opposite ends of the same handle; and our countrymen, forgetting the meaning of *curette,* have applied that name to the sharp cystitome instead of to the scoop. It is time that we called the things by their right names; for foreigners, in reading reports of English cases, must often have been sorely puzzled to understand how we lacerated a capsule, or transfixed a lens, with a *curette!*

recommends a crucial incision; another tells us to make a series of cuts crossing each other at right angles, so that the lines of incision may include a number of lozenge-shaped interspaces—a figure, one would think, rather difficult to execute within the area of the pupil, even in a motionless dead eye, and certainly not practicable upon the irritable eye of a patient under operation.

In tearing through the capsule, the surgeon should take care that the rents extend quite across the area of the pupil; and if he effects laceration to this extent, he need not trouble himself about lines of incision depicted in diagrams. The laceration of the capsule requires a careful eye and a light hand, otherwise the lens itself may be displaced, the capsule remaining unbroken.

The needle having been withdrawn, with due care against entangling it in the iris, the surgeon proceeds to the last act of the operation—the removal of the lens.

It is a fatal error to suppose that this removal is to be effected by main force; that the eye may be squeezed in any direction, if only it is squeezed hard enough. The real object of pressure is to make the lens first turn on its transverse axis, so that its upper edge may become tilted a little forwards. To effect this, the concavity of the scoop is laid against the lower lid—which the assistant is not to touch during this stage of the operation—and gentle pressure is to be applied through the lid against the sclerotic, a little beneath the lower margin of the cornea. With the forefinger of the hand which holds the upper lid, similar gentle pressure is made on the upper part of the globe, just above the section; and then, by a carefully-regulated alternating pressure on these two points, the lens is made slowly to turn and present its upper edge at the pupil. Coming in contact with the cornea, the edge of the lens is guided upwards, and begins to protrude at the corneal wound. It is evident that as soon as the widest part of the lens has passed through the pupil, the rest will be inclined rapidly to follow; and therefore, if the surgeon does not moderate his pressure, the lens will suddenly start forward, and will very probably be followed by a gush of vitreous humor. According to the size of the corneal wound, and the degree of superficial softening the cataract has undergone, will be the amount of soft matter the lens will leave behind in passing out of the eye. A small lens will perhaps escape entire through a large wound; while if the wound be small, and the lens bulky and much softened on its surface, a considerable quantity of lens-matter will remain in the pupil and about the lips of the wound.

Quick union of the corneal wound, upon which so much of the success of the operation depends, cannot take place if any foreign matter be allowed to remain between its edges; all soft lens-matter, therefore, which may be sticking there, must be carefully removed with the scoop. The iris, which very frequently protrudes, can be best returned to its position by means of the small spatula. It is unwise to dip again and again into the pupil with the scoop for the purpose of removing every portion of soft lens matter. The capsule cannot be removed by such means; and it is to this that the fragments very often adhere, and a too free use of the scoop is very likely to rupture the hyaloid membrane, and cause a gush of vitreous humor.

Provided the lips of the wound are in perfect apposition, and the iris in its proper place—which may be known by the central position of the pupil—the capsule, and any small portions of entangled lens-matter, may safely be left for future removal, after the wound is healed and all irritation has passed away.

When a gush of vitreous humor takes place at the moment the lens passes, the surgeon must immediately close down the upper lid, lifting it over the wound by the eyelashes, so as to prevent the edge of the tarsus catching against the projecting flap of cornea. Any prolonged examination of the wound can only lead to fresh escape of vitreous humor. After a slight pause, the surgeon, again grasping the lashes of the upper lid, may gently raise it, just sufficiently to assure himself that the flap is not doubled down, as frequently happens. Having ascertained that this displacement has not occurred, he must be satisfied, and not wait in the expectation of seeing the wound close; for the constant tendency of the vitreous humor to escape will render any adjustment of the flap impossible. The lids must at once be closed with strips of plaster and a bandage.

Although cases in which a small quantity of vitreous humor has been lost may ultimately do well, a deformity of the pupil always remains. It is large and drawn up towards the wound, and the iris forming the upper margin of the pupil retracts, so as to disappear altogether.

In the foregoing description of the operation by extraction, I have noticed some of the accidents that are liable to occur; but there remains to be noticed one more dangerous than all others, namely, *hemorrhage into the vitreous chamber*.

Although the corneal section may have

been perfectly well made, and every due precaution taken, it sometimes happens that a gush of vitreous humor, usually of watery consistence, occurs at the moment the lens escapes through the wound. Within a few seconds, or at the end of a minute or two, the patient complains of severe pain in the eye, and blood appears oozing from between the lids. This oozing does not take place until the whole cavity of the eyeball has become filled with blood. In some instances, the hemorrhage sets in several hours after the operation. Some diseased condition of the deep-seated tissues must exist in all these cases—a change of structure in the vessels of the choroid, with or without serous effusion between it and the retina. I need hardly say that, in all these instances of hemorrhage, sight is utterly lost.

A similar hemorrhage sometimes follows the removal of staphylomatous projections of the globe. As soon as the prominent portion of the staphyloma has been cut off, the pent-up aqueous fluid and serum, and the diffluent vitreous humor, gush out at the wound; and this sudden removal of support from the enlarged choroidal vessels causes them to give way. In such cases, I have found the whole retina enveloping the large clot which had been forced out of the eyeball; a proof that the blood which had detached the retina must have had its source behind that structure, namely, from the vessels of the choroid.[1]

AFTER-TREATMENT OF CASES OF EXTRACTION.

The prevalent belief that all operations for cataract are likely to be followed by "inflammation," and that the great aim of the surgeon is to keep this down, is of course unqualified in the popular mind by any definite notion as to the nature of this "inflammation," why it arises, or what parts of the eye it involves; and many members of the profession, when commencing the study of eye-diseases, have equally vague conceptions of the subject. Let us, then, examine a little into what takes place in an eye after flap-extraction of cataract. We will assume that the structure of the organ, with the exception of the lens, had been in a healthy condition, and that the operation has been skilfully performed.

The cornea has been divided, by a clean cut, to the extent of half its circumference; the aqueous fluid has escaped; the lens has been gently squeezed through the pupil; the iris is in contact with the hinder surface of the cornea, the cut edges of which are in exact apposition; the concave surface of the upper lid lies against the wound, and affords it support.

Within a few hours—provided the nutrition of the patient's body is in a healthy state—adhesion takes place between the cut edges of the cornea. As this adhesion becomes firm, the aqueous humor is retained; it once more fills the anterior chamber, and defends the iris from being pressed against the cornea. The slight irritation to which the iris has been subjected, by the passage of the lens through the pupil, passes off, and within a period longer or shorter, according to the constitution of the patient, the extra quantity of blood, which had been affording reparative material to unite the wound, ceases to be sent thither, and the cure is completed.

This is just what happens in accidental wounds of the cornea. If the patient be at the time in a good state of health—the wound a clean cut, unattended with contusion—with no iris or other substance interposed between its edges—and if the eye be carefully kept at rest, and defended from the action of light and other irritants—a few days suffice to heal the wound. But let a similar injury be inflicted on the eye of a person feeble from age—or of one reduced to feebleness by want—or of one alternately excited and depressed by intemperance—and suppose the first two patients to be bled and restricted to low diet, while the third continues his indulgence in alcohol—what will *then* be the result? Non-union of the wound; partial or total slough of the cornea; and morbid changes in the iris and adjacent tissues; finally, loss of the eye, as far as sight is concerned.

And now let us apply these facts to a case of extraction. If the operation has been properly conducted, and all has gone well, in the manner already described, healing of the wound is the natural result. No more blood will be sent to it than the healing process requires; and as soon as the process is completed, the extra supply will cease.

On the other hand, if the iris has been forced into the wound, a mechanical obstacle to quick union is thereby established, and union must take place by a slower process, effused lymph agglutinating the iris to the cut edges of the cornea, and then gradually drawing them together. If vitreous humor has escaped through the wound, its edges will be kept asunder for some time, but will eventually unite by adhesion.

If quick union is prevented by these or

[1] I published two cases of this kind in the Lancet, 1845, p. 623.

any other causes, what good can *bleeding* do? Will it dislodge the iris from between the lips of the wound? or, when the hyaloid membrane has been ruptured, will it prevent the vitreous body from protruding where it meets with the least resistance? As reasonably might we expect by bleeding to dislodge a piece of muscle that was preventing union by lying between the two ends of a fractured bone.

The pain which not unfrequently sets in a few hours after an extraction is commonly of a neuralgic kind. The patient's nervous system has been excited by anxiety about the operation itself, or its result. Bleeding is sure to increase this neuralgia; while a due supply of digestible food, a small quantity of stimulus, or a narcotic, will at once arrest the neuralgia and prevent its recurrence. And yet, only forty years ago, such doctrines as the following were taught *ex cathedrâ*, and are still accepted and followed by many in this country, and by a far greater number of surgeons on the Continent:—that within a few hours after the operation of extraction a quantity of blood should *always* be abstracted, *whether pain come or not;* that "from four to eight hours after the operation, unless pain has come on sooner, blood is again to be drawn from a large orifice,"—and yet again, "if pain should come on afterwards, or continue." For the first five days after the operation —while the patient is being drained of blood in this manner—his diet is to consist of "nothing but gruel, tea, arrow-root, and panada."[1] [Such practice is certainly unknown anywhere at this day.]

Extraction of cataract is an operation performed on those who are past the middle period of life, and one naturally expects to find among them many of those conditions of feebleness and impaired function which are incident to old age. No doubt cases occur of an opposite kind, in which the patients are plethoric, over-fed, over-stimulated with alcohol. They require to be "toned down," and their circulation brought into a more healthy state. But then this should be done by regulating their plan of living for several months *before* the operation is performed; not by bleeding them just *after*, and thus placing them in a new and unnatural condition at a period so critical.

The profession is chiefly indebted to the late Frederick Tyrrell for the introduction of a more rational and simple method of treating patients after extraction and other operations on the eye; although he did not so completely abandon bleeding as I am convinced he would have done had he been spared to acquire firmer faith in the *vis medicatrix naturæ*.[1]

As soon as an operation of extraction has been completed, and the surgeon has satisfied himself that the flap is in a proper position, he should at once close the eye, without permitting any such trials of the patient's sight as may safely be made after the removal of opaque capsule, or the formation of an artificial pupil. Such trials, immediately after extraction, are more likely to disappoint than to satisfy the patient; for when the media of the eye have just been disturbed, and the pupil is still encumbered with shreds of capsule, and perhaps fragments of lens also, objects must necessarily appear to the patient distorted and confused; whilst the opening and shutting of the lids is liable to displace the corneal flap. An assurance from the surgeon that all has gone well, and that, to restore good sight, time and patience only are needed, will effect much more towards tranquillizing the patient than any premature experiments.

Both eyes are to be covered with pieces of folded linen, which are kept in place by a light bandage passing around the head. Some surgeons apply strips of plaster across the lids, instead of a bandage; but I prefer the latter, as it effectually excludes light, and therefore does away with the necessity for darkening the room, while it affords to the patient a sense of security and protection. Liebreich's bandage is a great improvement on the old linen blinkers and roller; for it always keeps in place, and can be unfastened without moving the patient's head. A little square of linen is laid upon the closed lids, and over this a little pile of cotton-wool, and the whole is then fastened down with the knitted bandage.

For some hours after the operation the patient should remain on the couch, comfortably supported with pillows. When in bed the best position is on the back; but this is by no means to be insisted on if it becomes irksome, or makes the patient wakeful. That position is the best which is the most comfortable, and likely to induce sleep.

A narcotic is sometimes needed on the first night; and in some persons, especially those accustomed to opiates, it may require to be repeated for several nights in succession; but such cases form the exception, not the rule. Loss of appetite is so apt to follow the use of these drugs, that they should never be given without manifest necessity. I always prefer tincture of hyoscyamus to opium, as being far

[1] Guthrie, Lectures on the Operative Surgery of the Eye, 2d edit., 1827, p. 347.

[1] For much valuable information on this subject, consult vol. ii. of his Practical Work, etc.

less likely to cause discomfort the next day, or to confine the bowels.

The patient is of course to be thoroughly waited upon, so as to be spared every unnecessary movement or exertion. Tapes passed around the wrist and attached to the sides of the bedstead are a useful check upon sudden movements of the hands during sleep.

A moderate dose of opening medicine, given a day or two before the operation, will obviate the necessity for teasing the patient with purgatives during the first few days succeeding it. Old and feeble persons, especially those with any heart-disease, are sometimes seriously prostrated by being purged on the second or third day after the operation, just when it is so important that the healing process should be steadily advancing.

As regards diet, patients should not be deterred from taking a nutritious meal a suitable time before the operation; and a moderate quantity of easily-digested animal food should be given on each following day. [For the first few days, the food should be fluid.] In respect of stimulants, it is impossible to lay down any absolute rule. Those accustomed to take wine, beer, or spirits, must by no means be wholly debarred from them at a time when the nutrient power of the body is called upon to form a new material for repairing a breach of surface. In short, the surgeon's object must be carefully to regulate both food and stimulants according to the patient's previous habits; neither keeping him too high nor too low, but as near as possible up to the ordinary level of healthy vigor.

The daily cleansing of the lids requires caution; the object not being to prevent the eyelashes sticking together, for their agglutination forms the best safeguard against the patient prematurely opening the eye. The lower lid and cheek are to be cleansed with warm water, but the upper lid is on no account to be touched, for under its shelter lies the corneal wound, sudden pressure on which would induce great suffering, and might even cause the slightly-formed adhesion of the flap to give way.

The progress of the wound towards healing is to be judged of by the condition of the lid, and the quality of the secretion. If the patient complains only of an occasional pricking, or a sensation of grit; and if this can be traced to the slight involuntary movements of the wound against the lid; if this uneasiness subsides day by day; if the secretion consists of tears alone, or is mixed with a little of the natural conjunctival mucus; and if the skin of the upper eyelid retains its healthy appearance, and is free from redness and swelling—the surgeon may entertain the best hopes that a good union is going on.

An increased feeling of grit in the eye, coming on after the lapse of three or four days, and perhaps attended with neuralgia, would lead the surgeon to suspect that the section had yielded, and that *prolapsus iridis* had occurred.

The most unfavorable sign is a bright redness and a swelling of the upper lid, which sometimes appear on the second or third day after the operation, attended with a yellow puriform discharge. These appearances are commonly ushered in by a restless night, with headache and considerable depression both of body and mind. When the lid is raised, the ocular conjunctiva is found injected, and so œdematous that it overlaps the corneal margin (*chemosis*). The cornea itself is throughout yellow and opaque, so that no trace of iris can be discerned through it; the wound is gaping, and filled with bulging iris. Eventually the whole cornea softens, the flap sloughs, and the eyeball shrinks.

I have now and then seen this hopeless state of things come on after an operation, which had been perfectly well performed, and when the surgeon had every reason to expect a most successful result. In such cases there has probably been some degeneration of tissue in the vessels supplying the globe, and a weak condition of the heart itself.

The time that should be allowed to elapse after the operation, before the eye is examined, may vary according to circumstances. In a healthy patient, when there has been no pain in the eye, or other bad symptom, the wound may be found perfectly united as early as the third day after the operation. But, as a rule, the fourth day is quite soon enough for an examination; and whenever there has been any loss of vitreous humor, so that the healing process has been retarded, the fifth will be the earliest day on which the eye can be prudently exposed. Indeed, in an old or feeble person, a wound which on the fourth day is going on well, will be all the better for another day of rest; and it often happens that a premature exposure sets up irritation, and if the union be not firm, favors the subsequent yielding of the wound and prolapse of the iris.

If redness of the upper lid, attended with puriform discharge, comes on within the first two or three days, the surgeon should examine the eye just so far as to obtain a view of the lower part of the cornea, and ascertain whether it is becoming infiltrated with pus; and this may be done without exposing the wound itself.

It would be impossible to detail all the appearances which an eye may present when first examined after the operation; but it may be useful to describe some of

the leading points which present themselves, both in favorable and unfavorable cases.

1. The cornea may be transparent, with the exception of a little hazy line along the edge of the wound; the aqueous humor may have been re-secreted, and the plane of the iris vertical; the pupil being either clear and black, or filled with a flocculent mass of capsule and lens-matter, accordingly as the lens has come out clean, through a large wound, or has rubbed off some of its soft cortical substance in passing through a small one. Vision may extend to the recognition of large objects, such as the fingers of a hand; or, in consequence of the obstruction still remaining in the pupil, may be limited to mere perception of direct or reflected light. Some little redness of the sclerotic and conjunctiva will of course be present in every case, an additional supply of blood having been sent to repair the corneal wound.

The appearances above described are most satisfactory, and would encourage the surgeon to look forward to a successful result.

2. The eye may present all the foregoing appearances, with the exception of the iris being in contact with the hinder surface of the cornea. This absence of anterior chamber arises from one or other of the following causes: either the wound, although sufficiently united to keep the cornea in its proper curve, has not become so consolidated as to be perfectly water-tight, and the aqueous humor, therefore, escapes as fast as it is formed; or else this fluid, which seems to be chiefly secreted in the posterior aqueous chamber, may be so pent up there by the lens-matter filling the pupil, as to thrust the whole iris forwards against the cornea. In the former case, by keeping the eye closed for two or three days longer, and giving the patient a little more stimulus or tonic, the wound will become consolidated. In the other case, the iris will slowly recede as the lens-matter in the pupil becomes absorbed, but perhaps will not quite resume its vertical position until the capsule at a later period shall have been broken through with a needle.

It occasionally happens that although the corneal wound, when examined on the fourth or fifth day, appears well united, it subsequently gives way a little at some point, and allows a small portion of the iris to protrude, so as to cause slight displacement of the pupil.

3. The eye may be found in the following state: the cornea clear, the section gaping, and blocked up with iris, the latter having prolapsed into the wound, after being adjusted at the operation, and no union between the two structures having occurred, in consequence of the feeble condition of the patient. In these cases the parts on the fourth day after the operation may appear almost as if the wound had been just inflicted. Chronic inflammation is sure to be set up, and is often attended with neuralgia. In non-union of this kind, it is sometimes good practice to keep the eye uninterruptedly closed for five or six days after the first examination, provided the healthy appearance of the lids, and the absence of puriform secretion, give assurance that the healing process is advancing.

4. Still more unfavorable than the appearances above described are the following: in addition to a gaping section and prolapsus iridis, a cornea hazy throughout, so that the iris cannot be clearly discerned; the edges of the wound thickened, opaque, and creamy-looking; the sub-conjunctival tissue infiltrated with serum, and the conjunctiva itself reddened and elevated (*chemosis*).

These local changes have usually been ushered in with pain in the eye and head, restlessness, and depression. Extreme care is necessary to treat a patient under such circumstances. Narcotics will probably be required at night; of these hyoscyamus is the best, and bark and ammonia are almost sure to render good service in keeping up the appetite and restoring vigor to the flagging circulation. The diet will require the most careful management, so as to insure a sufficiency of nourishment being taken without oppressing the stomach; above all, the regulation of the supply of stimulants—wine or beer—will demand much judgment on the part of the surgeon, so that the patient's powers may be raised and sustained, without causing irritability and subsequent depression. But it will sometimes happen, in spite of care and skill, that such cases as these will terminate in closure of the pupil, with wasting and softening of the whole globe.

Although it is so important, after the operation of extraction, to defend the patient from strong light for several days, there is no necessity for closing shutters, and drawing curtains closely round the bed, if the patient's eyes have been bandaged in the manner I have described. Very moderate shading of the room is then sufficient, and thorough ventilation is most beneficial; for due aëration of the patient's blood is essential to the healing process.

Prolapsus iridis.—If the corneal section, instead of uniting by adhesion, has undergone that slower process of closure which takes place when a portion of iris is interposed between the edges of the wound, the *prolapsus* continues for some time to be a source of irritation. It should

not, however, be too hastily interfered with; for, in healthy subjects, it usually wastes and flattens down by slow degrees. Sometimes, however, instead of diminishing in this manner, it becomes distended into a little vesicle, in consequence of the accumulation of aqueous humor behind it. If the prolapsus fills up nearly the whole extent of the wound, the corneal flap may be tilted forward in such a manner as to form an obtuse angle with the lower portion, the base of the flap being marked by a transverse crease, extending quite across the cornea from one angle of the wound to the other. As the process of contraction in the prolapsed iris goes on, the edges of the corneal wound are gradually drawn together, the transverse crease disappears, and the natural curve of the cornea is eventually restored.

If, however, instead of diminishing, the prolapsus remains as a large and prominent vesicular projection several weeks after the operation, means must be taken to induce it to contract. In many cases it is sufficient to puncture it with a broad needle, and when the aqueous humor distending it has escaped, to touch the collapsed iris very lightly with a point of nitrate of silver. The eye must then be kept closed for a day or two. Should the prominence reappear, the application of nitrate of silver may require to be repeated; but it must never be used except with a light hand, a single touch being sufficient to whiten the surface.

Fistulous wound.—If a case be not well watched for several months after the operation of extraction, the wound may become fistulous. This is an extremely rare occurrence; so rare, indeed, as to be unnoticed by most of the authors on ophthalmic surgery. On this account, I will relate two cases which occurred under my own observation. In the first case, I could not quite satisfy myself as to whether the fistula resulted wholly from defective repair of the original wound made in extraction, or whether it was the consequence of a puncture I made in a very troublesome vesicular prolapsus.

In the second case, the prolapsed iris gave way spontaneously, many months after extraction, when the cure might have been considered complete.

1. Captain G., aged seventy-six, was operated on by extraction in the right eye, November 18, 1854. Nothing untoward occurred during the operation, and although a small portion of iris subsequently prolapsed into the wound, there was every reason to expect that its contraction and solidification would take place in the usual manner. By the end of the month, however, the prolapsus, instead of flattening down, became distended at one spot into a little vesicle. Meantime the pupil had of course become somewhat drawn upwards, and it was also obscured by a hazy condition of the flap; the lower half of the cornea always retaining its perfect transparency. On January 19, 1855, the vesicle still existed, and the anterior chamber had never been restored since the operation, the iris lying in contact with the cornea. It appeared to me, therefore, that at some part of the cicatrix a minute aperture must exist which allowed the aqueous humour slowly to exude. I punctured the vesicle with a cutting-needle, and touched the collapsed surface with a fine point of nitrate of silver. Three days later, I again touched it in the same manner. After a time the vesicle again became prominent; and on February 1, by the aid of a lens, I distinctly recognized the existence of a fistulous opening at its summit. The aperture was as minute as the section of a human hair, but pressure on the globe caused an escape of aqueous fluid to be distinctly perceived. I now coated a fine hair-like probe with a thin film of nitrate of silver, passed it quite into the minute fistulous track, and then kept the eye closed for several days. Meantime the patient's diet and allowance of stimulants, which had been liberal from the first, were increased. March 12, the vesicle had flattened down, but slight oozing from the fistula still continued. Nitrate of silver on the fine probe was twice repeated, at an interval of some days. By the end of May the cicatrix of the wound was quite flat, but a very slight oozing of aqueous humour still continued; so slight, indeed, that some little accumulation took place in the anterior chamber, so that the iris and cornea, although very close together, were not in actual contact.

It was now evident that it would eventually be necessary to draw the pupil downwards, from behind the hazy portion of cornea adjoining the cicatrix, and so bring it opposite the clear portion below. But of what avail would this be, unless the fistula could be closed? It appeared to me that by at once performing this displacement of the pupil, a double object might be attained, and that the wound made at the lower part of the cornea would for a time effectually drain off the aqueous humor, diverting it altogether from the fistula, which would thus be placed in a condition favorable to closure. Accordingly, on May 30, I made an opening at the lower part of the cornea with a broad needle; caught the lower edge of the pupil with a blunt hook, and drew out and cut off a very small portion of iris. An excellent pupil resulted. Ten days after the operation, I was much pleased to find the fistula closed and the aqueous humour completely retained, and this after a lapse of more than six months from the performance of extraction. Two years later the patient was still enjoying excellent vision, both for far and near objects, reading the editorial articles in the Times with a glass of two inches and a half focus.

In the foregoing case I had been induced, by special considerations, to perform extrac-

tion at a very late period of the year; and the winter, which soon afterwards set in, was unusually cold and protracted. It will long be remembered as the terribly severe winter of the Crimean campaign. No doubt the low temperature contributed to lessen the reparative power of so old a person; and the long continuance of frost and cutting winds, which kept him confined to the house till May, deprived him of the invigorating influence of exposure to the open air.

2. An elderly woman, from whose left eye I had extracted a cataract in 1857, came to me two years afterwards, complaining that the sight of this eye, which had been very good ever since the operation, had within a few weeks begun to fail. On carefully examining the eye, I observed that near the middle of the cicatrix, which was rather broad in consequence of some slight prolapsus iridis having followed the operation, there was a minute fistula, through which the aqueous humour was slowly oozing. The anterior chamber was nearly full, and the plane of the iris almost vertical, the escape through the very minute aperture being counterbalanced by the secretion of fresh fluid. The fistula was so minute that it might easily have escaped notice, and it was only by absorbing the moisture adjacent to it with a bit of blotting-paper, and protecting it from the trickling-down of the tears, that the welling-up of the aqueous humor could be positively demonstrated. I had no doubt that this fistula was of very recent formation, for otherwise the patient would not have enjoyed such good sight as had existed until within a few weeks of her coming to me. Probably the cicatrix had always been thin and tense, and now from some accidental cause it had given way at the weakest point.

At first I tried the effect of touching the fistulous orifice with a fine probe coated with nitrate of silver. This was done twice, and for a few days after the second application it appeared to have been successful; but again the little channel opened itself. I then made a counter-puncture with a broad needle at the lower part of the cornea, and let out the aqueous humour, having just before again introduced the fine probe coated with nitrate of silver into the fistulous orifice. The lids were kept in contact with strips of plaster. A week later the fistula was completely closed, and sight was improving.[1]

These fistulæ of the cornea are likely to be overlooked, on account of their extreme minuteness; for their aperture is sometimes no larger than the section of a human hair, and the quantity of fluid oozing out is small in proportion. The fistula of course allows a constant escape of aqueous humor, and the anterior chamber becomes obliterated, the iris lying in contact with the cornea. This drain of aqueous humor, if unchecked, seems to exert some peculiarly exhausting influence upon the eye, for in all the cases I have seen in which fistulæ of the cornea had existed for several years, all useful vision had become extinct.

There are certain points connected with the operation of flap extraction which may seem to have required notice before the operation itself was described; but it appeared preferable to reserve them for later consideration, because they can be properly appreciated by those only who have already made theselves acquainted with the details of the operation.

Inasmuch as extraction is performed upon persons more or less aged, it must often happen that the constitution of such patients has been damaged by various forms of acute or chronic disease before they come under our care as the subjects of cataract; so that we cannot expect to find them by any means in as favorable a condition for undergoing an operation as those whom we are in the habit of treating for many other surgical affections. There are, however, certain conditions which would either wholly contra-indicate extraction of cataract, or would cause us to undertake the operation only after the most careful preliminary examination, and unusual precautions against the more pressing difficulties of the case.

1. Extensive heart-disease is of all complications the most unfavorable; for, by enfeebling the supply of blood to the peripheral tissues of the body, it lessens the probability of a quick union of the corneal wound.

2. Violent cough, if occurring in suffocative paroxysms, would also greatly imperil the success of the operation; partly by the unavoidable restlessness and frequent change of posture, and partly by the straining and shaking of the eye, which may disturb the wound, and induce prolapsus of the iris.

3. Fat and flabby persons have much less reparative power than those who are thin. Dry and wrinkled, but still vigorous old people—such as are popularly termed "wiry"—are of all others the best adapted to undergo extraction.

4. Certain morbid conditions tend to render the operation in various ways difficult, although they by no means forbid its performance. Total deafness, and deaf-dumbness, for instance, in a great measure remove the patient from control; but I have successfully operated on patients under both these disadvantages.

5. Mere old age does not contra-indicate extraction; for one occasionally meets with persons of advanced years whose bodily functions are performed with

[1] This case was reported in the Medical Times and Gazette for August 27, 1859.

surprising regularity.[1] Commonly, however, the reparative power of the cornea is impaired after seventy.

6. If cataract is equally advanced in both eyes, and both appear equally well suited for operation, ought we to extract both lenses at one sitting? On this question much difference of opinion exists. My own judgment is decidedly in favor of operating on one eye only at a time. We learn much by watching the progress of a case after operation, and often see how, by this or that precaution, or course of treatment, a difficulty, or a bad result might have been avoided. We operate, for instance, on a depressible patient during very hot weather, and find him utterly overcome and prostrated by it, perhaps to such an extent as to induce non-union of the wound, or even partial slough of the cornea. Were this to occur after we had operated on one eye only, we should learn experience by the result, and take care to select a cooler season of the year for operating on the other eye.

Or our patient may have deceived us as to his previous habits. He may for years have been accustomed to take large quantities of stimulants, and our first operation may have failed because we had not kept up his reparative powers sufficiently by artificial aids. Having learned the truth too late to save the first eye, we might be able, by adopting a different plan of after-treatment, to save the second.

Without unnecessarily multiplying illustrations, I may say that by operating on one eye at a time we secure to ourselves the advantage of making our first operation a means of invaluable instruction with respect to the second; while, at the same time, the effort of nature in repairing a single corneal wound is of course less than is required for the repair of a second wound of equal extent.

7. Ought we to operate when a cataract is fully formed in one eye, while the other is either free from cataract, or only slightly impaired by its existence in an early stage?

Exceptional circumstances may make it desirable in such a case to operate on a cataractous eye; but in the great majority of cases it will be proper to wait until cataract is fully established in the other. Of course, after the extraction of the crystalline lens, a convex glass becomes necessary, to compensate for that portion of the optical apparatus of the organ which has been taken away; and it is almost, if not quite, impossible so to adjust any mechanical aids as to make the operated and the unoperated eye work well together. Each eye, taken separately, may be good; but there is a want of harmony between them which can never be be reconciled.

8. The last question to be considered is, whether any particular time of the year is to be preferred for the performance of extraction? As far as the mere operation itself is concerned, I know of no period being positively contra-indicated, except the extremes of hot and cold weather. Severe cold acts unfavorably on old people by retarding the circulation of blood in their capillaries; while extreme heat enfeebles the action of the heart, especially when it happens —as is so common in old age—that some organic change has already taken place in it. The only time which I systematically avoid for performing extraction is during that sultry weather which sometimes visits us in July and August.

But one has to consider not merely the operation itself; the period of complete repair and convalescence is equally important. It is of the utmost consequence that a patient who has gone through the confinement and the mental anxiety inseparable from so important an operation as that for cataract should at the earliest possible period enjoy the invigorating influence of change of air; and nothing tends so much to prolong that condition of chronic ophthalmia, which sometimes follows extraction, as too long a confinement to the sick room. A few days of careful exposure to the fresh air during genial weather equally improves the eye and the patient's general health. It is, therefore, of importance so to time the operation that the period of convalescence may coincide with the finer season of the year; and this can only be done by choosing the spring and early summer for the operation: April, May, and June are, therefore, the best months to select for extraction, although the later summer months may be chosen, provided the weather be not sultry and oppressive.

RECTILINEAR EXTRACTION.[1]

This operation is, as I have already observed, a modification of that invented

[1] Such was the case with a gentleman of eighty-six, upon whom I operated by extraction. I could really detect in him no organic defect whatever, and he lived six years after the operation, in the enjoyment of excellent health and good sight. He then suddenly fell ill, became jaundiced, and died after a few days' confinement to his bed.

[1] I have taken the liberty of using the word "rectilinear," instead of "linear" (the term by which Graefe designated his operation), because the wound made in the cornea is a straight one, in contradistinction to that of a flap extraction, which also forms a line, but a curved one.

by Gibson.[1] He advised that *soft* cataracts should be freely broken up with a needle, and that after inflammation had subsided —in three or four weeks—a small incision should be made in the cornea, and the broken-up lens removed with a scoop. As the true principles which regulate absorption of a cataract in its natural position, when its tissue has been carefully broken into with a needle, became better understood, Gibson's operation fell into disuse. The fallacy of his procedure was revealed by the words "after inflammation had subsided." If by breaking up all the lens at once inflammation was set up, the proper practice would have been at once to evacuate the lens-matter which was the cause of the inflammation. Either do this, or adopt the slower but safer course of only disintegrating the lens sufficiently to induce the absorbing process, without throwing the bulk of it into the anterior chamber all at once.

Graefe's operation[2] was the following. After having dilated the pupil with atropine, he made a straight vertical incision, two, two and a half, or three lines long, through the cornea, not at its margin, but about a line nearer its centre. Such a "linear" wound, he remarked, would heal more readily than a flap wound, and would involve less risk of *prolapsus iridis*. But, on the other hand, a rectilinear wound does not gape, and it therefore requires more manipulation to evacuate the pulpy lens-matter. Through the wound he passed in a small fleam-shaped cystitome, and with it broke up the capsule and the substance of the softened lens. Then a scoop was introduced into the midst of the pulpy mass, the wound was made to gape, by pressing the instrument against its edge, and the broken-up lens-matter escaped along the groove.

"Linear extraction" was not proposed by Graefe as a substitute for the older flap operation. He considered it to be specially suitable to cases of fluid lens, the corneal wound being made about two lines long; or when the lens was almost of a pulpy consistence, rather a longer incision being then required. When the lens had retained the normal consistence of adult life, and still more when in old age it had acquired increased hardness, he considered the operation contra-indicated.

In consequence of these limitations of the operation being disregarded, and its being applied to cases of firm cataract, it soon fell into discredit. I knew of many eyes being lost after linear extraction which, from the skill of the operators, I have no doubt would have been saved if treated by them on the slow but safe plan of solution *in situ*, or by flap extraction.

Removal of cataract by suction.—In 1847 Laugier announced a quick and easy method of removing softened cataracts by suction; "par aspiration," as he termed it. He thrust a sort of canula through the sclerotic into the substance of the lens, and then professed to draw out the contents of the capsule by means of a piston.[1] A less dangerous mode of operating was soon afterwards proposed by Blanchet, who employed a canula and syringe somewhat similar to Laugier's, but with the much safer modification of introducing the canula through a wound in the cornea. Suction fell into disuse, until it was revived, under a much more delicate and skilful form, by Teale,[2] in 1863. With two needles he tore up the capsule; then made a small wound in the cornea, through which he introduced a flattened canula, or curette, into the body of the lens. A flexible tube attached to the curette terminated at the other end in a mouth-piece, and the operator gently sucked out the softened lens-matter. A syringe has sometimes been substituted for the tube. The reader will at once see that this must needs be a very delicate proceeding, and that if a too great power of suction be employed, serious mischief to various tissues of the eye may ensue.

However applicable to the cataracts of adults suction may prove to be, it is quite uncalled for in the congenital cataracts of infants. As I have already observed (p. 124) a lens freely broken up, and even to a considerable extent displaced into the anterior chamber, does not at that early age set up irritation; and in a few months every trace becomes absorbed and disappears.

SCOOP EXTRACTION.

In many cases of cataract it is impossible to determine absolutely to what ex-

[1] Practical Observations on an Artificial Pupil, with Remarks on the Extraction of Soft Cataracts, 1811.

[2] Archiv für Ophthalmologie, ii., 217, 1855.

[1] Annales d'Oculistique, vol. xvii., p. 29. Laugier's operation gave occasion to a paper war, which soon grew into formidable proportions. First he was charged with having plagiarised his operation from some Italian surgeon; then an angry combatant declared that the Italian was himself but a plagiarist, and had been anticipated by the Arabians of the middle ages. Overlooking the fact that the Arabians did not know what a cataract was, nor where it was, their modern champion quoted Arabic and even Hebrew to prove their claims to priority of discovery. (See Annales, vols. xvii., xviii., xx., and xxiv.)

[2] Ophthalmic Hospital Reports, vol. iv., p. 197.

tent the softening process may have extended, and what amount of hard nucleus may still remain. It often happened, therefore, that the surgeon who had commenced the rectilinear operation in the belief that the whole lens was pulpy, found himself embarrassed by a firm nucleus of considerable size. The removal of this mass required so much mechanical interference, that the iris became bruised and injured, and also fragments of lens might remain behind the iris and set up the most serious irritation. These and other complications seem to have led Graefe to devise a mode of operation whereby the iris might be saved from injurious pressure, and at the same time additional room might be made for removing even a firm nucleus through a corneal wound smaller than that made in an ordinary flap extraction. The result of these attempts was the operation of scoop extraction.

And here I would observe that, whatever may be the final verdict which, after more extended experience, may await the operation of scoop extraction, its invention is wholly due to Graefe, who to a great degree has been deprived of the merit of having originated it.[1]

There is no doubt that one of the chief causes of failure after a well-performed flap extraction, is the occurrence of prolapsus iridis, and by the iridectomy proposed by Graefe all possibility of this was of course avoided. At the same time ample room was made for the removal of a large and solid nucleus, and through a less gaping wound than the crescentic incision of flap extraction. By the use of a scoop to draw out the nucleus, all pressure on the globe was rendered unnecessary.

Scoop extraction seems most suitable to those cataracts which are in an intermediate condition between the semi-fluid state which admits of a complete evacuation through a rectilinear incision, and the hardness of those in which little or no superficial change has taken place.

From the diminished risk of escape of vitreous humor, during scoop extraction, in consequence of the smaller corneal wound and the absence of pressure on the globe, the vomiting which so often follows the use of chloroform is of less consequence than in flap extraction; and therefore it may be administered in operations with the scoop, although in very quiet patients it may not be necessary.

The lids being well separated with a spring speculum, the surgeon fixes the globe, by nipping up a fold of ocular conjunctiva below the cornea. He then passes in a lance-knife at the upper edge of the cornea close to its junction with the sclerotic.[1] Next a forceps is passed in at the wound, a portion of iris seized, drawn out, and cut off. The cystitome is then used to lacerate the anterior capsule, which should be done to the full extent of the now enlarged pupil. Lastly, the scoop is insinuated behind the upper edge of the nucleus, and carried on until the beak of the instrument has passed just beyond the lower edge. The entire nucleus is then gently drawn out.

This sliding of the scoop behind the lens is the act of the operation which requires the most care, for by rudely thrusting the instrument too much backwards, its point might be made to break through into the vitreous humor. The surgeon must bear in mind the convexity of the hinder face of the lens, and give to the beak of the scoop a corresponding curved sweep.

It will depend upon the degree of softening which the surface of the lens has undergone, how much pulpy lens-matter will remain behind after the nucleus has been drawn out. As much of this pulp as can be got away without risk of breaking into the vitreous humor should be removed; but provided no solid nodules remain, the surgeon need not be over anxious to get out every particle of soft matter. Each reintroduction of the scoop tends in some degree to irritate the edges of the corneal wound, and there is always the risk I have adverted to of breaking through with the instrument into the vitreous humor. The corneal incision being left clear of any lens-matter, the bandage may be applied over both eyes, as after flap extraction.

On examining the eye for the first time, the surgeon will sometimes find that the whole, or nearly the whole, of the enlarged pupil is filled with a flocculent or pulpy mass; but provided the wound be united, and the cornea clear, this obstruction of the pupil need not disquiet him. All will in time become absorbed, or if any considerable quantity should eventually remain, it may be cleared away by the aid of two needles, used in the manner hereafter described.

In most cases the softened periphery of the lens is sufficiently opaque to be readily seen at the time of the operation; but it is sometimes so nearly transparent as to be very difficult of detection, and it

[1] The operation was very fully described by him in the fifth volume of the Archiv für Ophthalmologie, pp. 158–173, 1859.

[1] In his first description of the operation, Graefe advised that the cornea should be incised at its outer edge; but the deformity, and other disadvantages resulting from an over-large and misshapen pupil, are better obviated by making the incision upwards.

only becomes opaque and strikingly visible two or three days afterwards.

Although, from what I have said, it will be seen that the two great accidents which attend or follow flap extraction, loss of vitreous humor and prolapsus iridis, may be evaded by a carefully-performed scoop operation, let not the reader suppose that the latter mode is to be regarded as "extraction made easy," or that success is always to be looked for. Cases occur in which, after the most careful scoop extraction, infiltration and softening of the cornea take place; or a more chronic form of irritation ends in permanent opacity of a large portion.

Graefe's scoop operation with iridectomy has undergone several modifications. One consists in first performing iridectomy, then waiting till the corneal wound is healed, and the anterior chamber restored; and then, by a second operation, removing the cataract with the scoop.

Another modification is as follows. A crescentic incision of the cornea is made, and the lens removed, as in ordinary flap extraction. A forceps being then passed in at the wound, the iris is seized, drawn out, and cut off, just as in the operation for glaucoma; the whole being done while the patient is under chloroform.[1]

MODIFIED FLAP EXTRACTION.

This operation, the latest form of extraction that has emanated from the fertile invention of Graefe, has hardly yet acquired a settled name. It is frequently called "modified linear extraction;" but inasmuch as a considerable incision is made in the cornea, and the lens is brought out entire, by being pressed through the wound, the procedure certainly bears more resemblance to a flap extraction than either to the "linear" or the "scoop" modification.

The patient is brought under the influence of chloroform; the lids are separated with a speculum; and the eyeball is steadied by nipping up with a forceps a fold of conjunctiva below the cornea. The knife, which is long and very narrow, is made to pierce the sclerotic at about the distance of a third of a line from its junction with the upper and outer part of the cornea [*A*], so that the instrument, as it is thrust on, enters the anterior chamber quite at its re-entering angle. Having got the point clear into the chamber, the surgeon thrusts it on for a short distance downwards and inwards [towards *c*], then lowers the knife into a horizontal position, and brings the point out in the sclerotic at a spot opposite to that of its entrance [*B*]; the edge of the knife, which had been kept upwards, is now to be turned a little forwards, and the corneal section completed. The wound now lies under the still undivided conjunctiva; this is then cut through with the knife, so as to leave a little flap of the membrane loosely covering the wound. [Fig. 270.]

[Fig. 270.

Modified flap extraction; direction of incision.

The point of the knife is entered at *A*, and is directed towards *c*, until it has fairly passed into the anterior chamber. The handle is then depressed until the blade is horizontal, and the counter-puncture is made at *B*.]

The next step of the operation is to remove the upper part of the iris with forceps and scissors, to such an extent as may seem desirable; then all the anterior capsule is freely lacerated with the cystitome. Next the curette is to be laid upon the lower part of the cornea, and pressed in a direction upwards and backwards, so as to induce the upper edge of the lens to present at the section, and as the lens slowly advances, its egress is to be aided by the curette being steadily carried upwards, with gentle pressure, over the surface of the cornea; and if portions of the soft periphery of the cataract become detached, they are to be helped on in their upward course by repeating the gliding pressure with the curette. To prevent the epithelial surface of the cornea from being abraded during these movements of pressure, Graefe advises that the curette should be made of vulcanite instead of silver.

[This operation is known as the "modified linear," or "Graefe extraction," and may be considered the basis of the modern operation for cataract, though, perhaps, very few surgeons follow strictly the rules laid down by its originator. The incision is usually made more anterior, and the puncture and counter-puncture lower down. Many surgeons, while using the Graefe knife and performing an iridectomy, make an incision that approaches more nearly to that of the old flap operation. There have, also, been numerous modifications in the manner of opening

[1] As much of the success of the scoop operation depends on the form of the instrument itself, I must bear testimony to the superiority of that invented by Mr. Critchett, to which he has given the name of "vectis." (Ophthalmic Hospital Reports, iv., p. 315, 1865.)

the capsule, of which peripheral cystotomy is the latest.[1]]

EXTRACTION THROUGH THE SCLEROTIC.

I allude to this operation simply because it is mentioned in works on ophthalmic surgery. Those who first suggested it were misled by the apparent advantages of making a wound which would avoid any interference with either the cornea or the iris; but they overlooked the far more serious injury the eye must sustain from a large incision in the sclerotic and choroid, extensive loss of vitreous humor, and the introduction of instruments for seizing and dragging out the lens. The history of the operation is little more than a history of destroyed eyes; and those who wish to satisfy themselves on this point may refer to the cases quoted by Mackenzie in his Practical Treatise (4th edition, 1854, p. 812).

OPERATIONS ON OPAQUE CAPSULE.

I have elsewhere alluded to the statements of Stellwag and others respecting the so-called opacities of the capsule (p. 113). Surgically speaking, it matters not whether the capsule, which remains in the pupil after various forms of cataract operations, be in its very substance opaque, or whether it be only coated with opaque material. It obstructs vision, and must be removed.

After the lens has been got rid of by solution, the anterior and posterior portions of the capsule, which have been broken through at the centre, retract, and form a white ring, which is often wholly concealed when the iris is in its natural condition, only becoming visible when the pupil has been artificially dilated. Sometimes a band or two may stretch across the pupillary area.

After extraction also, it commonly happens that the shreds of torn capsule form a delicate film, blocking up the pupil; and if any slight degree of iritis has followed the operation, this film may be made additionally dense and visible by exudation of lymph. Even when the area of the pupil looks black and clear, some months after extraction, the surgeon should endeavor to keep the patient in view; for perhaps at the end of a year or so a filmy membrane will be found stretching across the pupil, so delicate as to be detected only after the closest scrutiny, and with the aid of concentrated light; and yet the existence of this film will just prevent the patient being able to read. Short of this point all objects may be seen well, and yet, for want of tact and care in detecting this slight obstruction to vision, the surgeon may lose the credit and the satisfaction of having performed a first-rate operation.

In some instances, the film, which forms many months after extraction, appears to be produced by an opacity of the hyaloid membrane advancing towards the plane of the pupil after the lens and its capsule have been removed.

There are no manipulations which demand more judgment and care than those for removing capsular obstructions. The two chief points to be observed are: to make the aperture in the capsule central, so that it may correspond to the axis of vision; and to avoid isolating any portions by completely detaching them from the rest of the membrane. Loose shreds, when set floating by unskilful management, are ever afterwards a source of annoyance to the patient. Above all, the division of the capsule is to be made with the least possible disturbance of the vitreous body.

Every movement of the needle should have a definite object. It is useless to make random stabs and plunges at detached portions of capsule, in the hope of depressing them by some lucky hit; for their buoyancy will almost always cause them to return to their former position as soon as the needle is withdrawn. Delicate bands, tightly stretched across the pupil, may be divided in the middle, and then each half will retract towards its fixed point, and leave the interval free.

[When the capsule is dense, Hays's knife-needle is the best instrument. It may often be used, also, in performing iridotomy.]

When a single needle is employed to tear through a portion of capsule, it sometimes happens that the delicate membrane yields and stretches, instead of being torn, and, after each attempt, the surgeon is mortified at seeing it return to its former position. It is in such cases that it is so efficacious to use two needles at once, as suggested by Bowman.[1] There is hardly any filmy expansion, or hair-like band, that may not by this means be divided.

The lids being held apart with a spring speculum, the surgeon has both hands at liberty, and he separately introduces the needles through the cornea, until their points reach the area of the pupil. He then, according to the nature of the obstruction, either makes in the centre of the opaque membrane a small hole, and

[1 See Archives of Ophthalmology, vol. viii., p. 218.]

[1] Medico-Chirurgical Transactions, 1853, vol. xxxvi., p. 315.

then enlarges it by drawing the points of the needles in opposite directions, or cuts, twists, or tears through some band or filament which had been holding together the margins of the pupil.

If the rules which I have said should guide the surgeon in effecting the absorption of a cataract be strictly adhered to, namely, to attack the lens at the centre, always working the needle steadily from that point towards the circumference, and to be satisfied with slow progress, without attempting to break up a large mass of lens at the earlier operations; and if he carefully avoids isolating and setting loose any portions of capsule—he will rarely find it necessary to employ any other instruments than needles for obtaining a perfectly clear pupil.

[When extraction is followed by iritis and capsulitis, the pupil is often obliterated and light is shut out by a dense tough membrane composed of altered iris, capsule and lymph (Fig. 271). In such cases

Fig. 271.

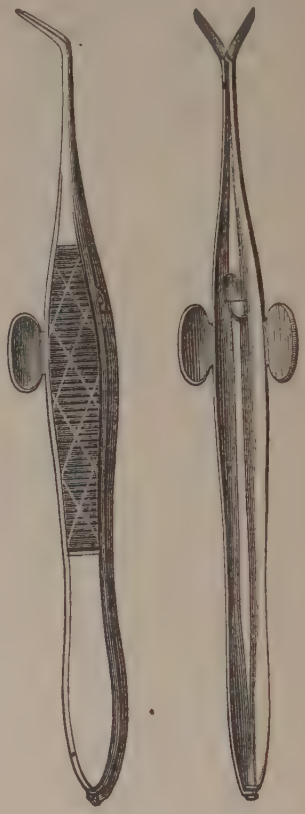
Tough membrane obliterating the pupil (Wells).

Wecker strongly recommends the operation of iridotomy by means of his forceps-scissors (Fig. 272). An opening is made in the cornea, with a Graefe knife or keratome, through which the blades of the scissors are introduced; one blade is passed through the iris and false membrane, and the other in front of it, and a free incision is made. If this does not dilate by contraction of the iris, another cut is made freeing a V-shaped piece, which shrinks and leaves a triangular opening. This operation sometimes gives good results in cases in which a needle would make no impression, and even an iridectomy would not be practicable.]

But if a case has already been unskilfully operated on, and the needle used roughly and without any settled aim, it may happen that the entire capsule containing some small remains of white lens-matter has become crumpled up and rolled into an opaque mass, which is either moored in the midst of the pupil by two or three delicate bands, or is attached by a single filament, which allows the mass of capsule to float and sway to and fro with every movement of the eye. In such a case the entire mass of capsule must be extracted.

To effect this, an incision of suitable size is to be made through the cornea near its edge, and a forceps introduced, the points being kept closed until they have reached the capsule. This is then seized, and withdrawn by gentle traction, sufficient to make the retaining filaments give way.

[Fig. 272.



Wecker's forceps-scissors for capsule-extraction.]

The forceps used for this purpose must be so constructed that, when its points are separated, the iris will not fall between them. The canula-forceps best fulfils this indication.

Far from having described in the foregoing pages all the operations which have hitherto been devised for the removal of cataract, my narrow limits, and still more a distaste for being a mere chronicler of minute differences of procedure, or abortive attempts at originality, have combined to limit my descriptions to those operations which have been approved of and practised by leading surgical authorities, or which have in some degree secured a reputation by retaining for a considerable period the confidence of the profession. A full account of all the cataract operations invented up to the present time, with a criticism of their relative value would form a work almost as large

as my present essay. I cannot, however, dismiss this most important subject of cataract without a few observations on the relative merits of the operations which are practised for its cure.

For cataract in children and young persons, solution of the lens by keratonyxis, if performed with the careful precautions mentioned at p. 124, appears to me to be a nearly perfect operation. The natural curve of the cornea is preserved; the pupil remains central; in short, all the structures of the globe are left, practically speaking, in their natural conditions, except that the offending lens is gone. The treatment, it is true, extends over several months, although in infants I have seen all the lens absorbed at the end of a few weeks. But even to a young adult, what is the delay of several months, nay, in extreme cases of caution in operating, what is the delay of a year, when good and lasting sight is eventually gained, compared with the patient's loss, when the surgeon, for the sake of a rapid cure, by his over-manipulation or his dangerous activity, calls up destructive inflammation in the eye he was anxious to save?

Sometimes in the course of the most careful treatment by solution, a sudden disruption and displacement of the whole lens occurs; nothing but an immediate incision of the cornea and removal of the irritating lens-matter, will then save the eye; but this accident seldom happens if proper precautions have been taken from the first.

With regard to extraction, all surgeons, I think, are agreed that, *provided all goes well*, the final result of a good flap operation is superior to that of any other procedure. In an eye where all the tissues are sound except the lens, such an operation skilfully performed, with careful after-treatment until the cure is completed, is a real triumph of surgery, only to be surpassed, perhaps, by the result of an equally perfect operation by solution. But then comes the all-important question, Is all as likely to go well with ordinary flap-extraction as with some of its modifications, or with the scoop operation?

The one great source of trouble after flap operation is prolapsus iridis. The surgeon may have done his part perfectly, his last look at the eye, before he puts on the bandage, may show him the iris in its proper position, with the pupil central, and the corneal wound in its closest apposition. For three or four days after the operation, the patient may be quite comfortable, and the eye hardly complained of; and yet when the surgeon makes his first examination, he may find the section gaping, plugged with a mass of iris, the pupil displaced or even drawn into the wound. Speedy cure or a shapely eye are henceforth unattainable; and the operator must be content if the cornea retains its transparency, and the other tissues are not too far injured by tedious inflammation to allow of sight being ultimately restored by the formation of an artificial pupil.

I know that many surgeons, in discussing the perils incident to flap extraction, would put forward, as one of the greatest sources of danger, the largeness of the corneal wound, as involving loss of vitality in the flap or a slow process of opacity in it. But I do not think that either of these disasters is often caused by the mere length of the incision; and, on the other hand, a free opening in the cornea allows the lens to escape without bruising the edges of the wound; and, what is of still more importance, without leaving behind it any considerable fragments of its cortical portion. Now this latter circumstance is inseparable from every case in which a lens is forced to squeeze itself out through a small aperture. In doing so it must scrape off more or less of its substance, and either these fragments remain, to set up irritation in the iris, or to insinuate themselves into the wound, and interfere with its quick union; or else they are removed by too much surgical interference, too frequent introduction of a scoop, or a suction-curette, or a syringe, or by too much squeezing and pressing of the eyeball. Overmuch manipulation of the eye is, I think, the radical fault both of the modified flap extraction and of the scoop extraction, and, indeed, of most of the attempted improvements of the flap operation.

As for loss of vitreous humor, which, without the slightest fault of the surgeon, sometimes takes place as soon as the corneal flap-wound is completed, it is equally liable to occur during scoop extraction, if the scoop is allowed to pass too deeply backwards, behind the lens, so as to rupture the hyaloid membrane; and an escape is still more probable during the squeezing and pressure which are inseparable from Graefe's modified flap operation.

In giving a preference to the older flap operation, as being, *upon the whole*, preferable to the other forms of extraction, I am quite aware how much I am influenced by the fact of my having been accustomed to the constant performance of the former operation for a period of nearly twenty years before any modification of it was invented. When I tried the scoop operation in cases which appeared to be especially suitable for it, I found that while the most successful cases left the patient with a deformed and enlarged pu-

pil, and with the optical annoyance of circles of dispersion, inseparable from that condition, I had in less favorable instances to contend with chronic opacity, insidiously invading the cornea, in patients whom I had selected for scoop operation in consequence of feeble reparative powers, which seemed to render dangerous the larger wound of a flap extraction.

In 1834, a celebrated surgeon of that day wrote an essay, "On the certainty and safety with which the operation for the extraction of a cataract from the human eye may be performed." Nine years later another surgeon announced "An easy mode of dividing the cornea in extraction." But in spite of these and other similar assurances—which were by no means borne out by the success of the gentlemen who published them—the really experienced and candid operator will confess that "extraction made easy" is still an undiscovered boon.

Every modification which has as yet been devised has some especial difficulty or danger. Only those who have had large opportunities of operating, and also of watching the results of the operations of others, can attain to a true estimate of the good and bad points in any given mode of treatment. Published statistical reports only mislead. To class cataract operations as "successful" and "unsuccessful" may please the public, but cannot afford real information to the honest and thoughtful practitioner. In general surgery, indeed, many of the most important operations may be thus abruptly divided. In classifying operations for ovarian disease, for instance, we are certain that the growth if left to itself will destroy the patient. If the tumor has been removed, and the patient restored to health, the operation has been successful. If, in consequence of the operation for removal, the patient has died, the operation was unsuccessful. So with the removal of a malignant growth—of a crushed limb—of a stone in the bladder, etc., every one can appreciate the classification of such cases into "successful" and "unsuccessful." But a successful operation for cataract, What is it? The mere removal of the opaque lens from the eye may be put down by one man as a success. The recovery of a patient with such an amount of sight as enables him to guide himself, is the success of another man. A third is satisfied if his patient can read a few large letters; while a fourth, with a higher standard of excellence, will accept nothing as success short of his patient's reading fluently a small type, and seeing distant objects with almost normal distinctness.

Then there is the professor who is so overwhelmed with the work of his clinique, that he must content himself with doing his operations as well as he can, not having the time, even if he had the inclination, to follow up his cases, and ascertain for himself their ultimate result. Of what value can his statistics be?

The "pious frauds" of charity committees, who hope, by startling reports of successful cases, to attract fresh subscriptions for the good of their institution, are not to be judged by a scientific standard. Such appeals are addressed to the general public, and are of no interest to the profession.

CHAPTER X.

GLAUCOMA.

"Glaucoma" is a term which in process of time has acquired a meaning quite different from that originally conveyed by it. Among the ancients "glaucoma" signified opacity of the lens, and was therefore regarded by them as a wholly incurable disease, inasmuch as to remove the lens from its position would have been deemed equivalent to displacing the very seat of sight. At a later period the etymology of the word caused it to be applied to many cases of greatly impaired or lost vision attended with fixed dilatation of the pupil; for, in such cases, the change of color which the lens naturally undergoes in old age, and some slight diminution of its transparency, combined to impart to the light reflected from the fundus of the eye a grayish or drab color, which, in descriptions, was exaggerated into green; and much labor was expended by ophthalmic writers, not many years ago, in attempts to explain the cause of this so-called green or *glaucous* tint. In fact, the dull grayish reflex, upon which so much stress was formerly laid, may be perceived, whenever the pupils are dilated, in the eyes of almost any old person whose lenses are beginning to be cloudy. ["It is, moreover, only an increase of the reflection perceived in mydriasis, irideremia, etc., and this increase results from the cloudiness of the dioptric media. In this regard, cloudiness of the aqueous has a particular direct determining influence, as the results of paracentesis corneæ show with certainty. The bluish cloudiness of the fundus is changed to a grayish green by the senile gilding of the nucleus of the lens."[1]]

The word "glaucoma" has now come

[1 Stellwag, On the Eye, p. 240.]

to be used—without any reference to its etymology, and in a purely arbitrary sense—to signify a disease gradually involving the most important tissues of the eyeball, and, if left to itself, ending in total blindness.

It is only since Graefe drew special attention to the subject, that the important *premonitory symptoms* of glaucoma have been estimated at their true value. Long before his time, the more advanced stage of glaucoma, and especially the strongly marked and unmistakable outward appearances of the disease in its complete form, were perfectly familiar to the profession; but the connection between this hopeless form of blindness and an earlier stage of inflammatory action was not understood; and the merit of explaining this connection, of showing how inevitably changes, apparently of no extreme urgency, lead the way to incurable loss of sight—above all, the invention of operative means for arresting these changes, and restoring the eye to usefulness—all this merit belongs to Graefe.

I will first notice the appearances of glaucoma in its complete stage.

The patients are beyond the middle period of life.

They are usually pale and unhealthy in appearance, often showing that worn expression which becomes impressed on persons who have gone through much suffering.

The eyeball, instead of having the slight degree of elasticity natural to it in health, is remarkably hard, giving to the finger almost the sensation of a stone.

The sclerotic, often marked with faint dusky patches, is traversed by large, purple, tortuous veins, which emerge abruptly, close to the margin of the cornea. Sometimes there is also a slightly-marked vascular zone.

The cornea, although it may be sufficiently transparent to allow of the iris being well seen, presents a peculiar unevenness of its epithelial surface; so that the lines of a window-frame, instead of being distinctly depicted on the corneal surface, appear wavy and irregular: and the reflected light is dull, like that from a slightly steamy glass. In some cases the cornea is hazy throughout its substance, and occasionally the epithelium is found vesicated in small patches.

If the state of the cornea allows a good view of the iris, these two structures will usually be found in close approximation to each other, the pupil being dilated to its fullest extent; sometimes the pupil is less dilated, but irregular. The change in the appearance of the iris is very characteristic. Its sharply defined fibrous character is lost, and it assumes a peculiar *slate-color*. Sometimes the veins of the iris are sufficiently enlarged to be distinctly visible to the naked eye.

The lens advances very near to the cornea, and in cases of old standing is opaque. Sometimes this opacity has a milky appearance, with slight indications of striæ, and the whole lens looks full and swollen, as if it had undergone maceration, and were about to burst its capsule. Occasionally the divisions between the planes of lens-fibres are very distinctly seen. The lens may vary much in color, appearing grayish or greenish drab, dirty yellow, or dull orange

Perception of objects is wholly lost; sometimes even, all perception of light.

An eye may present all the above-mentioned appearances in consequence of slow disease, advancing, with intervals of quiescence, during months, or even years; or, on the other hand, the same appearances may be the result of an acute inflammatory attack, coming on in a most sudden manner, and within a few days producing all the changes above noticed, with the exception of the opacity of the lens, which takes place more slowly.

Mere inspection of an eye in which glaucoma is complete will not enable the surgeon to decide whether the morbid changes have been the result of the *chronic* or the *acute* form of the disease.

I have already alluded to the merit of Graefe, in having been the first to connect that well-known incurable condition of the eye, to which alone the term glaucoma was formerly applied, with a definite train of premonitory symptoms, marking a period during which surgical treatment might be of service. These peculiar premonitory symptoms consist in intermittent attacks of dimness of sight. A patient perhaps sees well up to the middle of the day, then objects appear as if involved in smoke, and reading becomes difficult or impossible. This dimness may last for the rest of the day, and the next morning it may have quite passed off, to return again in the course of a few hours. This intermittent dimness may go on for months, with little, if any, external appearance of inflammation; in other cases, the onset of dimness is attended with slight redness and watering of the eyes. In fact, unless the peculiar premonitory symptoms of incipient glaucoma are well understood, a case of the most serious kind may be lightly regarded as one of unimportant catarrhal ophthalmia.

A luminous object, as a candle or a lamp, appears surrounded with a halo of prismatic colors. The iris approaches the cornea, and the pupil is inactive, although perhaps not dilated; and, unless the attack be very slight, the surface of the cornea instead of presenting a bril-

liant mirror-like smoothness, will appear slightly dull, like a glass that has been breathed upon; so that the lines of the window-frames will be reflected in a faint and wavy form. This uneven and dull appearance of the corneal epithelium is a very valuable diagnostic mark in all stages of glaucomatous disease, and will often arouse the suspicions of a careful observer in cases which might otherwise be thought unimportant. It is invariably present in all advanced and confirmed cases of glaucoma. The premonitory obscurations may persist for weeks, with occasional interruptions, even for months; and patients may be liable to intermittent attacks for a year or more, before any outburst of acute inflammation occurs. Neuralgia in the ophthalmic division of the fifth nerve, is commonly added to the other premonitory symptoms..

[A frequent symptom is more or less complete anæsthesia of the cornea, from pressure on the ciliary nerves, a result of increased intraocular tension. Another symptom, arising from the same cause, is a recession of the near point, necessitating a rapid increase in the strength of presbyopic glasses, which should always excite suspicion of glaucoma.]

If the eyeball be carefully examined during any period of glaucomatous disease, it will be found in some degree harder than natural. This hardness goes on increasing, until, in the last stage of glaucoma, the globe feels almost like a ball of stone.

I know of no instance in which the *tactus eruditus* of the surgeon is more severely tested, than in examining some of these incipient cases of glaucoma. The same eyeball may suggest to two able examiners different degrees of hardness, or they may even disagree as to whether the eye be abnormally hard at all.

While the patient gently closes the lids, the surgeon is carefully to apply the tips of his fingers upon the upper part of the globe, lightly pressing upon its coats. And again, when the patient opens the lids and looks upwards, the surgeon presses the middle part of the lower tarsus steadily against the sclerotic, just below the cornea, and carefully notes the degree of resistance he meets with. I need hardly say that too great softness of the globe is as much a mark of disease as too great hardness, and that, to discriminate truly between the various degrees of what is too hard and what is too soft, the surgeon must familiarize himself with the exact amount of firmness and elasticity indicative of a sound state of the coats and humors of the globe, by means of that careful fingering which repeated practice alone can give.

Donders and others have devised formulæ for noting down the amount of tension existing in the globe, but the gradations are so manifold, that it is barely possible to tabulate them correctly according to any fixed plan. [See page 43.]

Rest of the eyes, careful attention to general health, and iodide of potassium internally, I have found to constitute the best mode of treatment in this stage; but the patient must be warned as to the true significance of the symptoms, and as to the probable onset eventually of acute glaucoma.

[Sulphate of eserine has recently been much used in the early stages of glaucoma, when, for any reason, an immediate iridectomy is not considered advisable. From its property of diminishing intraocular tension, it will almost always produce at least temporary improvement. It has also been found useful in cases in which increased tension has recurred after iridectomy. A few drops of a two or four grain solution are applied to the conjunctiva. [Muriate of pilocarpine has also been recommended of late.]

The use of atropia should be carefully avoided when there is any suspicion of glaucoma, as, in a number of instances, it has been thought to be the exciting cause of the disease.]

It was to the ophthalmoscopic appearance of the optic nerve and its vessels, in all stages of glaucomatous disease, that Graefe drew such special attention. In well-marked cases the optic nerve [entrance] appears concave, and the retinal vessels, instead of passing off from their point of emergence in a straight direction, to ramify on the retina, begin by curving over the edge of the cup-like depression at the end of the nerve.[1] Very slight pressure on the globe with the finger causes visible pulsation in the retinal vessels; or this pulsation may exist without external pressure.

In the slowly-advancing early stage of glaucomatous disease, the depression of the optic nerve may be so trifling as to escape observation; but in confirmed cases it is very marked. When the disease has come to a crisis, and acute glaucoma has set in, the details of the optic nerve and retina cannot be seen with the ophthalmoscope, owing, I believe, in great part, to the condition of the corneal surface, which produces irregular refraction

[1] Plate XII., fig. 6. This is a diagram, not a drawing from an individual case. It shows, in a rough way, the abrupt curve of the vessels, the concave form of the optic disk, and the gray tint which the latter sometimes assumes in the very advanced stage of true glaucoma, or of gray atrophy of the optic nerve.

of the rays of light. In the advanced stage of glaucoma a dull red glow is sometimes all that can be seen.

As the disease goes on, the dimness of sight, instead of being intermittent, becomes permanent, and the field of vision gradually contracts, so that at last the patient in viewing objects seems to be looking at them through a small hole in a screen. Sometimes, however, this narrowing of the field of vision does not take place, the dimness being pretty uniformly diffused. [The field of vision is usually more contracted on the nasal side.] By this time other marked changes have taken place in the globe. It has acquired a peculiar stony hardness; the veins on the sclerotic emerge abruptly near the edge of the cornea as thick purple trunks; the pupil gradually dilates, until in old cases the iris almost disappears, acquiring at the same time a peculiar slaty tint. Eventually the veins of the iris enlarge, and are especially noticeable as a ring-like plexus near the pupillary margin. The lens at last becomes opaque, milky-looking, and indistinctly striated; it is often of a grayish drab, dirty yellow, or dull orange, and marked with earthy streaks and patches. Its threefold division is often very well marked, as if by undergoing maceration in water, it had swollen up and were about to burst its capsule. By this time even perception of light is usually quite lost.

From what I have already stated as to the various changes in glaucoma, it will be understood that it is by a careful comparison and estimate of several morbid appearances taken together, that the disease is to be discriminated, and not by the presence of any one distinctive sign. If mere abnormal hardness of the globe be assumed as the proof of glaucomatous change, several forms of inflammation and degeneration quite distinct from glaucoma may be mistaken for that disease. A "cupped" condition of the optic nerve may simply be the result of chronic wasting. Colored halos around luminous objects are commonly associated with ordinary catarrhal ophthalmia. But let all these symptoms co-exist—intermittent obscuration of vision, prismatic halos, fixity of the pupil, increased hardness of the globe, a changed condition of corneal epithelium, cupping of the optic nerve—and the diagnosis becomes an absolute certainty.

I have said that the course of the glaucomatous process is usually more or less gradual, a longer or shorter premonitory stage preceding the onset of an acute attack; but this sometimes comes on suddenly, frequently in the night, the patient having gone to bed apparently well, and being aroused from sleep by intense neuralgic pain to find himself all but blind. When such an attack occurs, on account of the hazy condition of the corneal epithelium, or some change in the vitreous body, or from both causes combined, the optic nerve and retina cannot be discerned, and the ophthalmoscope only reveals a dull red glow from the fundus.

Treatment of glaucoma.—While cases of chronic glaucoma which had advanced to their last stage were abandoned as wholly incurable, and beyond all treatment, those of the acute form (under the name of *ophthalmitis interna*, *ophthalmitis arthritica*, etc.) were formerly treated on antiphlogistic principles, pushed to the severest extremes; profuse bleeding, both local and general, and mercury in salivating doses, being the common means employed to check the progress of the disease. Some practitioners regarded gout as the primary cause, and, in addition to depletion, employed colchicum, or other anti-arthritics.

In spite of every form of treatment, glaucoma remained the *opprobrium* of ophthalmic medicine; and the announcement, therefore, of its curability by means of an operation at once attracted general attention. In 1857 Graefe[1] published an account of this operation of "Iridectomy," and he also brought the subject before the Ophthalmological Congress which met at Brussels in that year. An incision was to be made through the cornea, close to the sclerotic; a considerable portion of the iris was then to be grasped with a forceps, drawn out, and cut off. By this operation the "intraocular pressure," which was the cause of all the phenomena of glaucoma, would at once be removed.

His operation is performed as follows: The globe having been fixed with a forceps, a lance-knife is passed obliquely through the sclerotic, about a line and a half from the spot where it blends with the cornea, so as to make a wound penetrating into the anterior chamber. An iris-forceps is then passed through the wound, a fold of iris seized, drawn out, and then cut off close to its ciliary attachment. Graefe and others lay particular stress upon the iris being removed quite

[1] See his essay in the Archiv für Ophthalmologie (vol. iii., p. 456), entitled, On Iridectomy in Glaucoma, and on the Glaucomatous Process. Also (vol. iv., p. 127, 1858), Farther Clinical Remarks on Glaucoma, Glaucomatous Diseases, and the Curative Effects of Iridectomy. These two essays, together with another, On Coremorphosis as a Remedy in Iritis and Iridochoroiditis, were translated, under slightly changed titles, by Mr. J. Windsor, and published by the New Sydenham Society (vol. v., 1859).

up to this point, but I do not believe it to be at all essential. I have always performed the operation with a Beer's knife, making, in fact, a corneal wound like the upper section of flap extraction, but on a much smaller scale. The wound is a good deal anterior to that recommended by Graefe, and passes through the true cornea, but close to its sclerotic union. The iris, consequently, is not divided quite up to its ciliary attachment; and yet I have found the result of the operation just as satisfactory as that first described. In acute glaucoma the lens always advances forwards, close up to the cornea, and is therefore endangered by the thrust made with the lance-knife; whereas, in using Beer's knife, in the way I have mentioned, its point is always kept in front of the iris as it lies against the projecting lens. It appears to me that if a peripheral portion of iris is removed, sufficient to establish a free communication between the anterior and posterior chambers of the aqueous humor, the object of the operation has been attained.[1] [Most authors make a point of removing the iris close to its ciliary attachment. A sixth or fifth of the membrane should be excised. Many surgeons use the narrow Graefe knife instead of the keratome, proceeding as in the first stage of cataract extraction, except that the incision is not so large.]

Hancock has recommended the following operation in glaucoma, as being greatly preferable to iridectomy: The point of a cataract-knife is inserted at the lower and outer part of the edge of the cornea, and carried in a direction obliquely downwards, dividing the sclerotic to about the extent of two lines, and penetrating through the corpus ciliare into the vitreous humor. The incision also divides the attachment of the iris, and the delicate fibres constituting the "ciliary muscle." The division of these fibres, which I have already spoken of as chiefly constituting the apparatus for changing the form of the lens in the act of accommodation, is regarded by Hancock as the essential point of the operation, since he believes their spasmodic contraction to be the primary cause of the phenomena of glaucoma.

In performing the operation of iridectomy, great care must be taken to avoid wounding the lens, which, as I have said, always projects towards the cornea, and is sometimes in actual contact with it. This danger is avoided by making the corneal incision in the way I have recommended.

A good deal of blood usually flows from the cut iris into the anterior chamber, sometimes quite filling it. This blood soon becomes absorbed, if the eye is kept at rest, and bandaged with a carefully adjusted amount of pressure, for twenty-four hours. When, after this period, the eye is examined, the cornea is found to be clear, and the peculiar unevenness of its epithelial surface has given place to the normal mirror-like smoothness.

The recovery of sight after well-timed and well-performed iridectomy is most remarkable, in many cases almost amounting to the restoration of former good vision; but in other instances the patient is greatly annoyed by the dazzling appearance and the distortion of luminous bodies, the result of the over large pupil, and the consequent flooding of the eye with light. Tinted glasses, an opaque diaphragm perforated by a narrow transverse slit, either with or without a low convex glass, or other optical contrivances, must be resorted to according to the circumstances of the case. But even if, with all these appliances, the patient is still annoyed by irregular refraction, this comparatively trifling inconvenience is not to be put in comparison with the benefits of iridectomy, without which utter blindness must inevitably have closed the scene.

The precise rationale of iridectomy as a curative means still remains to be accounted for; and it must so remain until we become acquainted with the first origin of glaucoma. We speak, indeed, of the disease as consisting in "intra-ocular pressure," but why the fluid contents of the globe are in excess, so as to cause this pressure, is as yet unexplained. We must be satisfied practically to employ iridectomy, without being able to give any clear theoretical reason for our procedure.

[Of late years, the operation of sclerotomy, as a substitute for iridectomy, has had numerous advocates and has given rise to much discussion. The most approved method is that of Wecker, who makes the same incision, with a Graefe knife, as in cataract, except that he does not complete it, but leaves a bridge of corneo-sclerotic tissue at the top with a cut on each side of it. This bridge diminishes

[1] If this view be correct, the explanation which those who prefer Hancock's operation have offered, as accounting for the beneficial effect of iridectomy, becomes inconclusive. They consider that the unintentional division of the fibres of the ciliary muscle, during the performance of Graefe's operation, and not the removal of the piece of iris, constitutes its real value. But if iridectomy, performed in the way I have recommended, be found as effectual as when the iris is removed quite up to its ciliary attachment, it follows that division of the ciliary muscle can in no way contribute to the beneficial result of the operation.

the tendency to prolapse of the iris, which has been a serious objection to the operation. The rationale of its curative action is not more satisfactorily determined than that of iridectomy, and it has by no means displaced the older operation. Its strongest claims are, perhaps, in cases of absolute glaucoma, when atrophy of the iris may make iridectomy difficult, and in the hemorrhagic form, when iridectomy is liable to be followed by profuse choroidal hemorrhage. The operation of sclerotomy may be considered still on trial.]

Scrofulous and Malignant Deposits within the Eyeball.

As the present treatise on Diseases of the Eye forms part of a general system of surgery, special sections of which describe the pathology of morbid growths, whether malignant, or otherwise, I have not thought it necessary to go into the subject of such growths, in connection with the eye, except just so far as they have relation to diagnosis and treatment.

Scrofulous and encephaloid deposits, differing so essentially from each other in their histology, and in the ultimate effects they produce upon the eye, nevertheless present at a certain stage of their progress almost the same external appearances.

It is chiefly in infants and young children that encephaloid and scrofulous deposits take place, while melanosis is the form more commonly met with in adults.

In scrofulous and encephaloid cases, the first symptom noticed is a yellowish reflection from behind the pupil, having more or less of a metallic brilliancy, like that seen in a cat's eye. The surgeon will find it difficult to form a decided diagnosis at this early stage of the disease. The pupil for a time retains its mobility, and it will therefore be necessary to apply atropine before using the ophthalmoscope; the employment of which, I need hardly say, is often very difficult with timid or restless children.

The retina will be found thrust forwards as an irregularly lobulated mass, and enlarged vessels will be seen ramifying over the uneven surface. As disease advances, the pupil becomes dilated and fixed, so that the ophthalmoscope can be used without any previous application of atropine. The mass slowly advances until it almost touches the hinder surface of the lens, which, up to this period, retains its transparency. Hitherto the patient suffers little pain, there is hardly a trace of increased vascularity about the conjunctiva or sclerotic, and the general health appears little, if at all, affected.

In the second stage, however, both redness and pain set in. The lens becomes cloudy, so that the deposit at the fundus of the eye can no longer be recognized, except by the indistinct yellowish tint which it transmits through the lens. The sclerotic and conjunctiva become deeply injected, and, so soon as the lens begins to press against the cornea, there is a considerable flow of tears, with intolerance of light. The patient becomes restless and feverish, with loss of appetite and irregular action of the bowels. In this second stage the eyeball becomes enlarged and the cornea opaque. The sclerotic bulges at one spot, as if matter were forming there, or it becomes soft and fluctuating in several places. Usually the softening is most marked just behind the upper margin of the cornea.

Up to this point it will have been difficult, if not impossible, for the most experienced surgeon to pronounce, with absolute certainty, whether the disease under his observation be scrofulous or encephaloid. In either case, the sclerotic usually gives way at the most projecting spot, the humors escape, frequently the lens also, and, for a short period, pain ceases, and the patient's general health improves.

If the case be one of *scrofulous* deposit the disease may now begin to subside, the globe slowly wasting, until, eventually, a mere nodule remains at the bottom of the orbit. Indeed, in some scrofulous cases the globe does not burst at all; but, having become enlarged to a considerable extent, slowly begins to shrink, and at last undergoes atrophy. After destroying one eye, scrofulous disease will sometimes attack the other, with the same result.

[The products of suppurative choroiditis have frequently been mistaken for intraocular growths. Dr. Knapp, in his "Treatise on Intraocular Tumors," says: "If I were to rely only on the results obtained from my own observations, ocular tumors would hardly admit of more than two varieties, viz., *Glioma*, originating in the *retina;* and *Sarcoma*, proceeding from the *choroid*, and being in part *unpigmented* and in part *melanotic*. . . . That other varieties of tumor (especially carcinoma) may arise in the eye I am far from denying; nevertheless, I may add that in the more detailed descriptions contained in medical literature, to the present date, I did not find any convincing instance."]

But should the deposit be *encephaloid*, a farther change now begins. A soft vascular growth sprouts forth from the opening in the sclerotic, through which the humors of the eye have escaped. This fungous mass enlarges with great rapidity, frequently attaining an enormous

size, and exudes a profuse fœtid sanies, which, by exposure to the air, dries into brownish crusts, giving to the tumor almost the appearance of a sponge. The separation of one of these crusts, or a very slight touch, often causes bleeding from the vessels which traverse the tumor in every direction. The patient becomes more emaciated and weak, and, after several months of suffering, dies, either from repeated loss of blood, or from the simultaneous development of malignant disease in the brain, or some other important organ.

Melanosis is the form of malignant disease which attacks the eye in adult life. Sometimes the melanoid deposit is so abundant that the whole mass acquires a brownish-black tint; in other instances it is only partially distributed through an encephaloid growth. Although more commonly commencing in an eye not previously diseased, melanosis sometimes attacks one which has already become useless from destructive inflammation.

It is between the choroid and retina that melanotic deposit most frequently takes place; and the visual power of a portion of the retina is often retained to a remarkable degree, while the rest of it has become completely displaced. The same remark holds good also in encephaloid cases. The ophthalmoscope is of course our only means for arriving at an accurate diagnosis of melanotic deposit within the vitreous chamber. When it has burst through the coats of the globe, its dark color and general appearance would at once proclaim its real nature. Occasionally melanosis appears to originate outside the globe, in connection with the conjunctiva, subsequently involving the sclerotic and other tissues.

The medical *treatment* of encephaloid and melanotic deposits within the globe, as in other parts of the body, can be only palliative. We may lay it down as a rule in the treatment of such affections, that, while we know of no substance which can cure them, they may often be kept in check for a considerable time by supporting the general powers of the patient; and the more we are able to do this, the slower will be the progress of the malignant growth, and the less tendency will it evince to involve the neighboring tissues. Strict attention to the patient's diet, and to the regulation of his health by means of suitable tonic medicines and pure air, will often retard to a remarkable degree the fatal termination of the disease.

In endeavoring to form an opinion as to the curative results of *surgical operation* in malignant disease of the eyeball, we must altogether dismiss, as untrustworthy, the records of our older surgery. For many of the eyes said to have been removed without any return of disease were doubtless affected with scrofulous deposit, which, as I have said, at a certain stage of its progress, so closely resembles the encephaloid form. Removal of the eyeball should be undertaken only after the most careful examination, both local and general. The surgeon should inquire into the mode in which the various bodily functions are performed, so as to assure himself that no appreciable deposit of a malignant kind has taken place in any of the viscera. He must, as far as possible, ascertain that the encephaloid or melanotic mass is fairly inclosed within the fibrous case of the eye, without having involved the optic nerve, or penetrated through the sclerotic into the cavity of the orbit. These conditions cannot be absolutely determined; but attention to certain points will help the surgeon to make some approximation towards a correct diagnosis. If the eyeball be thrust forwards, without its actual volume being increased—if it be habitually turned in any particular direction—if it be fixed, or only movable to a very slight degree—above all, if the point of the little finger passed backwards by the side of the globe, encounters any resisting mass within the orbit, it may fairly be assumed that the morbid deposit extends beyond the cavity of the eyeball; and in such a case its removal would be of doubtful success. Even under the most favorable circumstances the surgeon, when convinced of the existence of a malignant growth, would give a most guarded prognosis; for in no class of operations for the removal of such disease are the statistics more discouraging than in those relating to the eye.

[Perhaps this statement may be understood as including operations undertaken in the later stages of the disease. Before the growth has penetrated the sclerotic or cornea, or involved the optic nerve, the conditions would seem to be exceptionally favorable, as "we are enabled to carry out the total extirpation with more certainty here than in any other portion of the body."]

CHAPTER XI.

DISEASES OF THE LACRYMAL APPARATUS.

The lacrymal apparatus comprises the lacrymal gland, which secretes the tears—the puncta and canaliculi, which convey them into the lacrymal sac, where they temporarily accumulate—and the

lacrymo-nasal canal, whereby they are finally conveyed into the lower chamber of the nose.

If we consider the small calibre of the canaliculi we can readily understand that a very slight degree of thickening in the delicate membrane which lines them, or a trifling displacement of the puncta, can suffice to disarrange the mechanism of taking up and carrying on the tears; and accordingly we find that watering of the eye (*epiphora*) is a frequent symptom in various forms of conjunctival inflammation. It also constitutes of itself a troublesome condition, which is constantly being brought under the surgeon's notice.

If the puncta are quite impervious, of course the tears must trickle down the cheek as fast as they are secreted. A contraction or stricture of the puncta or canaliculi will cause a less complete overflow. If the lacrymo-nasal canal be strictured, or its outlet obstructed, the tears passing into the sac will accumulate there, and, together with the pent-up mucus, form a swelling termed *mucocele*. Unless relief is obtained, the distended sac becomes inflamed, and pus is formed, which eventually discharges itself through an opening in the skin, constituting true *fistula lacrymalis*. This term, however, is often incorrectly applied to abscess of the sac without any perforation of the skin.

When a case comes before us in which there is a continual watery state of the eye, our attention should be at once directed to the puncta. These apertures, in a healthy state, are in contact with the ocular conjunctiva, so that, to bring them into view, it is necessary to draw the margin of the tarsus a little away from the eyeball. If the conjunctiva lining the lower lid has become considerably thickened from chronic inflammation, the edge of the tarsus may be so much everted as to cause the punctum to face upwards, or even directly forwards. In such a position it can no longer take up the tears, which accordingly run over the edge of the lid. In extreme cases of *lippitudo* and chronic ophthalmia, the puncta, still retaining their natural position, are sometimes found to be so completely obliterated that their position can no longer be detected.

If the puncta are in their natural position, and their openings appear unobstructed, and yet no tears can be made to regurgitate through them when the point of the finger is firmly pressed against the lacrymal sac, just below the tendon of the orbicularis palpebrarum, we may suspect some stricture to exist in the canaliculi. We can ascertain this only by exploring them with a fine probe. This may seem to be a very simple matter; but it requires considerable care and tact, without which much serious mischief may result. The membrane lining the canals is extremely delicate, and any want of gentleness in passing the probe may tear the membrane, and so give rise to fresh obstruction. We must bear in mind the abrupt turn which the canal makes at a short distance from the punctum. In passing a probe into the lower canaliculus, the instrument should be directed almost vertically downwards for about half a line and then turned inwards towards the nose, in which direction it will pass on, should no stricture exist, until its point strikes against the inner wall of the sac, where it lies against the bone. During the whole process of introducing the probe, the tarsi should be kept on the stretch, by drawing outwards the external canthus.

Except to a practised hand, it is often difficult to detect whether the point of the probe is arrested close to the junction of the canaliculus with the external wall of the sac, or whether the point has reached the internal wall. In the former case any onward pressure with the instrument produces a slight dragging of the tarsus; whereas contact of the probe with the inner wall of the sac not only conveys to the hand a peculiar feeling of firm resistance, but at once causes all movement of the tarsus to cease.

If the canaliculi be found free from stricture, and the sac forms a distinct prominence below the inner canthus, it is pretty certain there is an obstruction at the lacrymo-nasal canal. If this canal be perfectly closed, while the canaliculi are free, firm pressure of the finger on the swollen sac will cause its contents to escape at the puncta; but if the canal, although narrowed, be pervious, steady pressure in a direction downwards and a little backwards, may overcome the resistance of the stricture; the swelling then suddenly yields, and the contents of the sac pass into the nose.

When we consider that the membrane lining the outlet of the lacrymo-nasal canal is that common to the chambers of the nose, we cannot be surprised that catarrhal inflammation of this membrane should be a frequent cause of lacrymal obstruction. If pressure on the sac suffices to empty its contents into the nostril, the inconvenience of the partial obstruction at the outlet may be kept in check by the patient taking care frequently to make this pressure, and to use at the same time other means for restoring the lining membrane of the sac as well as that of the nose to a more healthy condition. But if this pressure is omitted, and the tears and mucus are allowed to collect and to distend the sac, this distension,

under some attack of catarrhal inflammation, may suddenly transform the chronic disease into an acute one. Pain is then felt in the part; the lids become red and puffy, sometimes assuming an erysipelatous appearance; and the patient is quite unable to separate the tarsi. The swollen sac feels hard to the touch, and even slight pressure on it is extremely painful, while it fails to press out anything from the puncta.

These symptoms show that suppuration is taking place within the sac. If the case is left to itself, the pus escapes by bursting through the skin, and the opening frequently remains fistulous, allowing the tears, which have passed through the puncta into the sac, to trickle out upon the cheek, thus constituting a true *fistula lacrymalis*. After all inflammation has passed away, and the redness and swelling which attended the formation of the abscess have disappeared, the fistula often contracts to such a small aperture, that, were it not for the tears which slowly distil from it, the opening would hardly be perceptible. It is about the size of a pinhole, and almost resembles one of the puncta in minuteness of aperture.

Treatment of lacrymal obstructions. — These obstructions, varying as they do from a slight thickening of some portion of the lining membrane of the sac or nasal canal, causing occasional watering of the eye, up to a total occlusion of the nasal canal, with displacement or stricture of the puncta and canaliculi, cannot of course all require the same kind of treatment. Slight cases of thickening of the lining membrane of the sac, if of recent date, may be much benefited by the repeated application of small oval blisters, about half an inch long, over the sac. Astringent solutions of alum or tannin may, at the same time, be dropped into the corner of the eye, so that they may follow the course of the tears, and thus reach the thickened membrane. This object may be facilitated by slitting up the canaliculus in the manner hereafter to be described. Each time the drops are used, the sac should be previously emptied, by pressing the point of the finger upon it in a downward direction. Should the lining membrane of the nose be in a thickened state, injections of astringent lotions into the nostril are of service; and in all cases attention to the general health and suitable tonic medicines are indicated.

Warm water-dressing should be applied whenever acute inflammation of the sac sets in with the symptoms I have described. This form of applying warmth and moisture is, in all affections of the lids and parts about the eye, to be preferred to poultices, as the latter frequently produce a troublesome form of eczematous eruption. Diligent application of water-dressing for four-and-twenty hours will frequently subdue acute inflammation of the sac to such an extent that not only do the redness and swelling of the lids disappear, but the thickening of the internal membrane gives way; so that gentle pressure over the sac suffices to empty its contents into the nose, and the case returns to its chronic condition. Should this not be the case, an incision must be made into the sac, and exit given to the pus.

[It is better, if possible, to empty the sac by slitting the canaliculus. This prepares the way for probing the duct after the acute symptoms have subsided, and avoids the formation of a fistula.]

There is hardly any form of local disease which has given rise to a greater variety of surgical treatment than chronic distension of the lacrymal sac, and stricture of its nasal duct. The distended sac has been compressed by an apparatus of pads, adjusted by means of springs and screws. The strictured sac or duct has been subjected to gradual dilatation by means of strings of catgut, introduced through an opening made into the sac, and brought out into the nostril; strings of increasing thickness being used as the canal would admit of their passage. Dilatation of the stricture was at one time attempted from below, by means of curved sounds, introduced into the sac from the nostril; but these instruments were difficult to introduce, there was great risk of breaking with them some of the fragile bones in the neighborhood of the nasal duct, and they could not reach a stricture situated high up towards the entrance of the canaliculi. At one time metal tubes were placed in the cavity of the sac, which were intended to be healed in, and permanently to occupy its cavity; but Nature, disliking foreign bodies, even when introduced by a surgeon, always rebelled against them, and did her best to dislodge them, either upwards or downwards. The *style* maintained its ground longest, and until recently formed the *ultima ratio* in every case of obstinate lacrymal obstruction. It was made long enough to reach from just below the tendon of the orbicularis palpebrarum, where an incision was made into the cavity of the sac to admit it, to near the floor of the nostril. The upper end was furnished with a nail-like head, to support the style in its proper position; and it was intended that the tears, entering by the puncta and canaliculi, should come into contact with the piece of metal, and glide down by the side of it into the nose. The style was to be taken out every day, cleansed and replaced; and at first the cure appeared

perfect; but patients, from timidity, awkwardness, or carelessness, neglected this precaution, the instrument was seldom, in some cases never, removed, and eventually it became encrusted with earthy deposit from the tears, or was consumed by oxydation; the skin around the nail-shaped head was drawn in, and at the same time blackened with the sulphuret of silver,—in short, the style, so highly praised at first, became at last a source of annoyance and disappointment.

About thirty years ago, Bowman[1] suggested a very simple and useful operation, which, in many instances, suffices to cure *epiphora* resulting from contraction or displacement of the puncta, while at the same time it affords a ready access to any obstruction that may exist in the course of the sac or lacrymo-nasal canal.

Suppose that, in consequence of chronic ophthalmia, or from any other cause, the lower punctum has become displaced, so that, instead of facing towards the eyeball, it is directed upwards and forwards; the tears in such a case will run over the edge of the lid; and the object of the surgeon must be to transfer, as it were, the displaced punctum to a position where it can catch the tears before they overflow the border of the tarsus. The lid being put upon the stretch, a fine grooved director, or, in default of that, an ordinary punctum-probe, is to be passed along the whole course of the canaliculus, and held firmly there, while a fine sharp-pointed knife is run along the probe, as far as the caruncle, so as completely to lay open the canal, and thus extend its orifice backwards to the point where the tears accumulate. A very handy little knife, with a slightly bulbous point, has been invented, with which the canaliculus can be slit up without the use of any probe or director.

[Fig. 273.

Weber's canaliculus knife.]

For several days after the incision has been made through the upper wall of the canaliculus a probe must be passed along its track, to prevent the lips of the wound growing together. In some persons it may be necessary to use the probe for ten days or more; in other cases there is hardly any disposition in the edges of the wound to unite.

When the overflow of tears depends simply on faulty position of the punctum, this laying open of the canaliculus may of itself effect a cure. In cases of obstruction in the lacrymal sac or its nasal duct, the incision affords an easy access to the seat of stricture.

Occasionally, however, another complication exists in a narrowing of the canaliculus just at its point of communication with the sac, which may prevent the passage of a probe sufficiently large to act upon the stricture. In such a case a small straight canula, containing a lancet-shaped point, which may be protruded or withdrawn by means of a spring,—in fact, Stafford's instrument for dividing urethral stricture, made on a miniature scale,—must be carried along the canaliculus, and employed upon the constricted spot.

The probes for dilating strictures in the sac or its canal must be of various degrees of thickness, but all sufficiently strong to sustain the requisite amount of pressure without bending. They are best introduced by the surgeon standing behind the patient; and it will be found advisable to avoid using those of too small a size, as they are of course more likely than those of a larger size to catch in a fold of membrane, or even to pierce the membrane covering the bony walls of the canal.

The tarsus being put on the stretch, the probe is passed along the newly-opened canaliculus until its extremity strikes against the inner wall of the sac. Still keeping its extremity in contact with this part, the probe is raised to a vertical position, and then carefully carried downwards to the seat of stricture. The canal inclines somewhat backwards, and this inclination is to be carefully borne in mind. The surgeon must feel his way with the point of the instrument, and be on his guard against using unnecessary force. In cases of old dilatation of the sac, its relaxed lining membrane readily catches in a fold against the point of the probe, and the surgeon must learn to discriminate between a check arising from this cause, and the obstacle encountered by the instrument becoming impacted in the constricted lacrymo-nasal canal. The length

[1] Medico-Chirurgical Transactions for 1851, p. 338.

of the instrument which has been passed in, and the patient's own feelings, will prove whether the point of the probe has entered the nasal cavity.

It sometimes happens that, immediately after the first passage of the probe, the surgeon is able, by pressure over the sac, to force all its contents down into the nose; but if there has been much difficulty in passing the instrument, the membrane becomes swollen, and will allow the contents of the sac to pass only after the swelling has been relieved by fomentation.

No fixed rules can be laid down as to the frequency with which the probe is to be used, nor as to the length of time required for a cure. This will vary from a few weeks to several months, and relapses frequently occur long after the stricture appears to have been completely overcome. Too frequent use of the probe will set up irritation, and induce a more abundant muco-purulent secretion. When this takes place, the probe must be laid aside for a week or two, and fomentation, with water-dressing at night, be substituted.

During the whole course of treatment by means of the probes, the patient must never neglect several times a day to press out the contents of the sac, endeavoring to do this in a downward direction; or, if this cannot be effected, by pressure through the puncta.

Those who are about to treat a case of long-standing lacrymal obstruction by the passage of probes, should clearly understand how much care, tact, and patience such an undertaking requires. In consequence of the minuteness and delicacy of the parts concerned, the treatment of a stricture in the lacrymo-nasal duct demands even greater care and skill than that of a stricture in the urethra; and I am sure that those who have seen much practice will bear me out in asserting, that by far the greater part of obstinate and dangerous cases of the latter kind are due to meddlesome surgery rather than to any original disease.

The surgeon must bear in mind that the walls of the lacrymal sac and duct are composed of extremely brittle and fragile bones, and that the rough introduction of a probe may either break some of these, or tear away the delicate and vascular membrane which covers them. Besides, as the lacrymo-nasal canal is a bony tube, all thickening of its lining membrane must take place concentrically; and therefore any undue violence, by setting up inflammation, is sure to increase instead of lessening the cause of stricture.

Even when all possible care and skill have been employed, the treatment of stricture in the lacrymal passages, by the means just described, is often extremely tedious; for the affection may be complicated with great dilatation of the sac, caries of the adjacent bones, or false passages of various kinds, resulting from previous mismanagement.

[The dilatation of stricture of the nasal duct by means of much larger probes than those heretofore employed, has recently been recommended by Dr. Theobald, of Baltimore. (See Archives of Ophthalmology, vol. vi., and Trans. Med. and Chirurg. Faculty of Maryland, April, 1877.)]

Dacryoliths. — This term has been applied to certain concretions which are sometimes met with in the lacrymal passages, in the canaliculi, or in the sac, caused by the earthy salts contained in tears becoming deposited in the form of a calculus. Watering of the eye, repeated attacks of inflammation in the sac, or swelling and suppuration about the canaliculus, and pain when the part is pressed upon, are the more obvious symptoms. A probe carefully passed into the canaliculus, or through it into the sac, would detect the presence of the concretion, which must be cut upon, and extracted with a scoop or other instrument.

Irritation of the lacrymal passages is sometimes caused by the intrusion of a detached eyelash into one of the canaliculi. In this curious accident the hair enters at the punctum, and passes on as far as the abrupt bend which the canal makes at about a line's distance from the orifice. Here it is arrested; its point protruding to a greater or less extent, and irritating the caruncle and semilunar fold. The symptoms induced are a pricking and itching about the inner canthus, with reddening of the neighboring conjunctiva. If the hair be short, its point will protrude so little as to make it very difficult of detection; on its withdrawal, all irritation at once ceases.

DISEASES OF THE LACRYMAL GLAND AND ITS DUCTS.

The works of foreign writers present a formidable array of diseases affecting this gland, almost every form of acute and chronic inflammation, and enlargements, both simple and malignant, being recorded; while our own countrymen appear to have met with but few cases of the kind. My own experience would lead me to believe that compared with the other glandular structures of the body, the lacrymal gland is very rarely the seat of disease. Its sheltered position beneath the projection of the frontal bone guards it, to a great extent, from external violence, and it appears but seldom to participate in the inflammation of neighboring tissues.

One rare affection consists in an accumulation of tears in one or more of the obstructed excretory ducts, whereby a cyst-like tumor is formed in the upper-lid (*dacryops*) becoming very visible when the lid is everted. If one of these enlargements is punctured, without attention being paid to the after-treatment of the case, the opening is apt to become fistulous (*dacryops fistulosus*), the lacrymal secretion continuing to distil through a minute aperture in the skin. Such a case may be treated on the same principle as a fistula of the parotid gland, namely, by passing in at the opening a thread, which, having been carried through the thickness of the lid, and brought out at its conjunctival surface, has a small knot made at one end. This knot is then drawn into the fistula, and, by continued traction of the other end, is made to ulcerate its way through the conjunctival surface. The tears being thus diverted, the fistulous orifice in the skin may be closed by paring and uniting its edges.[1]

Should the lacrymal gland really become the seat of malignant deposit, or should it be deemed advisable to extirpate it on account of chronic enlargement, or for any other cause, the operation would be a simple one, and would offer nothing worthy of remark.

In the only instances, three in number, where I have myself extirpated the gland, it was not the seat of disease, but was removed to do away with the inconvenience of the overflow of tears, the puncta and canaliculi having been wholly destroyed by extensive burns. In one of these cases an artificial pupil I had made would have been rendered almost useless, in consequence of the flooding of the eye with tears, had their secretion been allowed to continue.[2]

CHAPTER XII.

DISEASES OF THE EYELIDS.

So many various tissues enter into the formation of the eyelids that they must necessarily be liable to a great variety of diseases; but it would be absurd to attempt a description of all the morbid conditions which they share with the other portions of the common integument of the body.

The *orbicularis palpebrarum* is subject to a spasmodic twitching of some of its fibres, usually those of the lower lid, producing a visible quivering of the skin, popularly termed the "live-blood." To persons of an irritable nervous system this becomes teasing from its frequent recurrence. It is commonly the result of intestinal irritation, especially that produced by ascarides; and a few doses of purgative medicine, followed up by tonics, usually suffice to put an end to the annoyance.

Epicanthus is a term applied to a slight deformity, sometimes observed in children, consisting in a crescentic fold of redundant skin at the inner corner of each eye, partly or wholly concealing the caruncle. It is associated with a depressed form of the nasal bones, and if, in after life, the bridge of the nose becomes more prominent, the fold of the skin, to a certain extent, diminishes, although it never wholly disappears. *Epicanthus* imparts to the face an unpleasant, Chinese expression; and the only cure is by pinching up and removing the vertical fold of skin on the median plane, just between the eyebrows, and then bringing the wound accurately together.

Ptosis, or, drooping of the upper lid, may exist in various degrees, producing merely a slight deformity, or becoming complete, so as wholly to obstruct vision. It will be spoken of under "paralysis of the third nerve." In some cases of congenital drooping of the lids it is possible that the levator palpebræ muscle may be altogether wanting. Patients with this defect have no power of moving the lids except by calling into action the occipito-frontalis muscle. The lids do not present that transverse fold in the skin, which, in the normal state, corresponds to the upper part of the eyeball, but are smooth and unwrinkled from the eyebrow to the tarsus, while the forehead is furrowed by the frequent action of the occipito-frontalis.

[This condition may be much improved by removing a piece of the skin of the lid by two curved incisions, and bringing the cut edges together. The upper incision should be just below the eyebrow, and the piece of skin as large as can be removed without exposing the cornea. The lid is in this way brought more under the control of the occipito-frontalis.]

The terms *Entropion* and *Ectropion* are respectively applied to the inversion and eversion of the margins of the lids.

The simplest form of *entropion* is that which is occasionally met with in children, the subjects of irritable ophthalmia, as a result of spasm of the orbicularis

[1] See a well-reported case of *dacryops*, by Hulke, Ophthalmic Hospital Reports, vol. i., p. 287, 1859. In this instance a loop of thread was made to include a certain portion of the conjunctiva.

[2] See Guide to the Practical Study of Diseases of the Eye, 2d edit., 1859, p. 417.

palpebrarum. Extreme intolerance of light induces this muscle to contract so often and so forcibly that at last the lower tarsus rolls over against the globe, causing an inversion of the eyelashes, which greatly adds to the patient's distress. Contractile collodion, painted on the skin of the lower lid, draws the part into a proper position, and keeps it so while suitable remedies are being employed to subdue the original disease.

[The most efficient remedy for spasmodic entropion, and I often the best means of promoting the cure of the original disease, is the operation of canthoplasty. A free horizontal incision is made, with a bistoury or a strong pair of scissors, through the external canthus, extending to the edge of the orbit and involving the skin and conjunctiva. The cut edges of the skin and conjunctiva are then brought together with sutures, and the contracted commissure is thus permanently enlarged at the same time that the orbicularis muscle is weakened. This simple operation is indicated in many cases of granular, purulent, and phlyctenular opthalmia, even when there is no entropion, for the relief of injurious pressure upon the cornea by permanent contraction or spasmodic action of the lids. It should never be omitted when there is an irritable fissure in the skin beyond the canthus. If a temporary effect only is desired, it may be obtained by simply slitting the canthus without using sutures.]

A similar spasmodic inversion of the lower lid happens to old persons, in whom the skin is relaxed and the tarsus flaccid. The muscular contraction is repeated until at last the lid becomes so rolled upon itself, that both the cilia and the tarsus are completely hidden, and the border of the lid appears to be formed of common integument. In these cases of extreme inversion the irritation is really much less than when the inversion exists to a slight degree. For in the latter case the points of the cilia are brought into direct contact with the ocular conjunctiva, while in the former case the tarsus rolls over so completely, that the points of the cilia become buried in the fold of palpebral conjunctiva, and consequently do not come into contact with the globe at all.

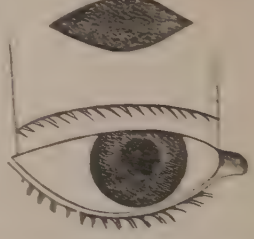
A far more severe and obstinate kind of entropion is that which follows chronic inflammation of the palpebral conjunctiva, especially neglected or maltreated purulent ophthalmia. The upper tarsal cartilage becomes so much curved upon itself, that the whole range of eyelashes turns backwards against the globe. This curving of the tarsus is often aggravated by the long-continued application of solid nitrate of silver and sulphate of copper to a granular conjunctiva. If in such cases we evert the lid, we find a pale smooth cicatrix occupying its deep concavity. Partial or complete inversion of the margin of the lids may also result from contraction of the conjunctiva, following injury from acids, caustic alkalies, or burns.

A great variety of operations has been devised for the cure of entropion. In that form, so common in old persons, where the inversion is owing to contraction of the orbicularis muscle acting upon a flaccid lid, a cure can usually be effected by removing an elliptical portion of the skin of the lid, together with the subjacent fasciculus of muscle, and then accurately uniting the wound with fine sutures. It requires care exactly to calculate what quantity of skin should be taken away; and of course the removal of too large a portion would cause eversion of the lid, and so produce a deformity of the opposite kind.

If the tarsal cartilage be so much curved that removal of skin is insufficient to draw the eyelashes away from the globe, recourse may be had to an expedient suggested by Streatfeild. The skin of the lid being carefully dissected up, sufficiently to expose the convex surface of the tarsal cartilage, a long narrow wedge-shaped slice is cut out from this, so as to form a groove extending the whole length of the tarsus. The curved cartilage thus becomes bent backwards, as it were, and the skin being restored to its position, is united along the cut edges with a few fine sutures.

[One of the best of the innumerable plans that have been recommended for the cure of entropion, is the operation known as Arlt's, or some modification of it to suit individual cases. The free edge of the lid is split to the depth of two or three lines or more, by an incision passing between the lashes and the Meibomian ducts, into two layers; the anterior containing the skin and the bulbs of the lashes, and the posterior the cartilage. The anterior portion is then drawn upwards and the lashes turned outwards by removing an elliptical piece of the skin of the lid, and bringing the cut edges toge-

[Fig. 274.



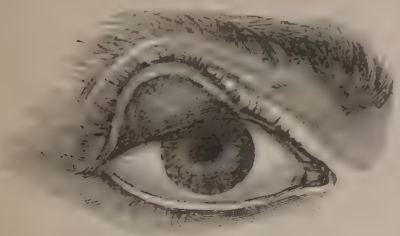
Arlt's operation for entropion (Wells).]

ther by sutures. A canthoplasty may generally be advantageously combined with this, or in fact with any other operation for entropion. Graefe made two vertical incisions, commencing at the ends of the first incision and passing through the skin and muscle, and then drew up the lashes by removing an oval piece of the skin of the lid (Fig. 274).

Should all these plans fail, and the eyelashes still irritate the globe, the whole row must be dissected off, together with that portion of the tarsal margin in which their roots are imbedded.

Ectropion, or eversion of the lids, may exist in the most various degrees. Its worst form is seen as a result of burns of the face, followed by extensive contraction of the cicatrices [Fig. 275].

[Fig. 275.



Ectropion (Wells).]

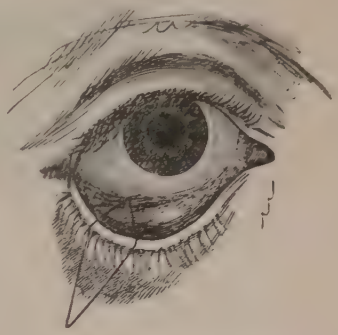
A spasmodic form of ectropion is often seen in the purulent ophthalmia of infants, and in the scrofulous and irritable ophthalmia of older children. In infants the unsightly appearance of the bright red and swollen conjunctiva gives rise to great alarm in those who have the care of the child; but they may be assured that as the inflammation subsides, the deformity will gradually cease.

The chronic forms of *ectropion* in adults, which are produced by granular thickening of the conjunctiva after purulent ophthalmia, or by the contraction of cicatrices in the skin surrounding the palpebral aperture, the result of ulcers, burns, exfoliation of bone, etc., require a variety of operations, according to the special nature of the case.

When, after chronic ophthalmia, the everted conjunctiva of the lower lid presents a thick mass of granular excrescences, without any material elongation of the tarsus, or disease of the neighboring skin, a cure may sometimes be effected by removing with scissors the greater portion of the palpebral conjunctiva, and then uniting the edges of the wound with very fine sutures. These may be left to ulcerate out by themselves, the lid being kept in proper position by the aid of a pad of lint laid along the margin of the tarsus, and fixed by means of several layers of lint saturated with collodion. In this way the lids are kept in contact with each other, and the apparatus need not be disturbed for several days. When the wound in the palpebral conjunctiva is closed, the loose stitches may be removed, and the pad of lint replaced until the cure is complete.

In very old and severe cases of ectropion, the tarsus becomes so much stretched, that, in addition to the removal

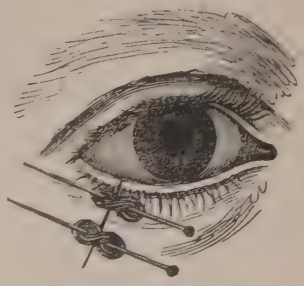
[Fig. 276.



Operation for ectropion (Wells.)]

of the conjunctiva, it is necessary to take away a wedge-shaped portion of the elongated lid itself [Fig. 276]. Still worse cases, such as those resulting from

[Fig. 277.



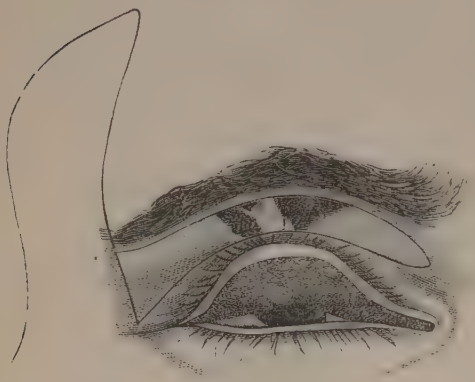
The same, completed (Wells.)]

burns or disease of bone, may require the formation of a new eyelid by the transplantation of a portion of adjacent healthy skin [Fig. 278, p. 158].

Trichiasis consists in an irregular growth of the eyelashes, the general form of the tarsus itself not being changed. Tinea ciliaris very commonly causes trichiasis, by inducing cicatrization about the roots of the cilia. Sometimes three or four fine eyelashes present their points towards the globe, or even a single hair will grow in this direction, all the other hairs maintaining their natural position.

Trichiasis, when existing only to a slight extent, causes constant annoyance to the patient, by a sense of pricking, and by the constantly irritable and watery state of the eye which it induces. If only a few hairs grow irregularly, the removal of the entire tarsal margin need not be resorted to. The offending hairs must be carefully plucked out from time to time; or if they form a little group, they may be removed by dissecting out the small portion of the lid external to the tarsus itself, in which their roots are implanted, and then uniting the wound with a suture.

[Fig. 278.



Plastic operation for ectropion (Wells).]

To draw out an eyelash by the root seems a very simple and trifling matter; and yet there are few surgical manipulations in which care and the skilful use of a well-made instrument are so necessary. The ciliary-forceps one commonly meets with are liable to cut the hair instead of merely grasping it firmly; and the stiff broken stump of a hair causes far more distress to the patient than its natural fine point. The hair should never be sharply jerked out, but removed with a slow steady pull.

INFLAMMATION OF THE LIDS.

The eyelids are of course liable to the various forms of inflammation which attack similar tissues in other parts of the body. A few inflammatory affections of the lids seem to demand notice on account of their presenting peculiarities of appearance, or being distinguished by special names.

A *stye* (*hordeolum*) is in fact a minute boil. It begins at the very edge of the lid, as a small, red, tense swelling, and at first is merely troublesome by the itching and sense of stiffness it occasions. As the inflammation goes on, the redness and swelling may more or less involve the whole lid, so that the eye becomes completely closed. In a few days matter forms, and shows itself at the summit of the stye; the cuticle gives way, pus and a small slough of areolar tissue escape; and then the redness and swelling subside, and the lid soon assumes its former appearance.

Scrofulous and delicate children are the usual subjects of styes, and they are comparatively rare in adults. Attention to the state of the bowels, carefully regulated diet, and the use of tonics, comprise the general treatment. Locally, warm water-dressings are greatly to be preferred to poultices, which are apt to irritate the skin. The stye should never be rubbed or squeezed; and no incision is necessary, except perhaps a slight puncture through the cuticle when the pus is pointing.

Abscess sometimes occurs in the Meibomian follicles. These organs pour out upon the edges of the lids a greasy secretion, which prevents the tears running over, and causes them to flow onwards to the puncta. Sometimes a follicle becomes obstructed at the orifice, and the retained secretion forms a minute solid granule, looking, when extracted, like a little grain of sand. If it projects sufficiently to touch the globe, a slight irritation is produced until the granule is removed.

If, however, the solidified secretion cannot in this way escape through the orifice of the follicle, it causes irritation, and at last a small abscess in the follicle itself. The lower lid is commonly the seat of these abscesses. They commence with a small patch of vascularity in the palpebral conjunctiva, a short distance from the free border of the tarsus, and gradually a yellow dot of pus forms in the centre of the vascular patch. If the conjunctiva at this point be punctured with a lancet, and a small scoop be introduced, the cause of the suppuration, a little nodule of stearine, about the size of a poppy-seed, may usually be turned out, and then all irritation subsides.

Tinea ciliaris,—termed also *ophthalmia tarsi*, *psorophthalmia*, *tinea palpebrarum*, [ciliary blepharitis], etc.,—is one of the most common and troublesome diseases of the lids. It is too often neglected during the early stage, when alone it is really curable, and the surgeon is probably consulted for the first time when many of the hair-bulbs have already been irreparably destroyed, and the remaining hairs are misplaced and inverted, constituting the

state called *trichiasis*. This term is frequently employed as if synonymous with entropion, but it ought properly to be restricted to mean displacement of the *hairs* themselves, while entropion signifies a turning-in of the *lid*.

Tinea ciliaris is seldom seen in its early pustular form; for the little pustules at the roots of the eyelashes soon break, and the discharge exuded from them dries into crusts, which cling about the hairs, matting them together, and sometimes almost concealing them from view. Tinea ciliaris, if allowed to go on unchecked, gradually destroys the tissues which secrete the hairs; and when the disease has thus exhausted itself, and the last crusts have fallen off, the tarsus, instead of presenting sharply-beveled edges, appears rounded off, the skin and conjunctiva being gradually blended together into one smooth, red, shining cicatrix, in which neither cilia nor Meibomian orifices can be traced. Very often the puncta also become obliterated, and the tears consequently run over the cheeks, causing irritability and blinking of the lids. This is the condition to which the term *lippitudo* should be restricted; *tinea ciliaris* being understood to mean that state in which active disease at the root of the eyelashes is still going on.

In the *treatment* of tinea ciliaris, the chief difficulty arises from the age of the patients. Daily attention is required, to prevent the accumulation of crusts, which should be carefully washed off night and morning. Patients often derive but little benefit from the remedies prescribed, in consequence of this regular cleansing being neglected. It is useless to apply ointments anywhere except upon the very surface of the minute sores at the roots of the hairs; and if the latter are kept closely cut with scissors, the application of ointments, and the prevention of crusts, are greatly facilitated. Of course, this cutting of the eyelashes requires to be done by the surgeon himself, and the ointment should be neatly applied with a pencil. When cases cannot be thoroughly looked after, it is perhaps better to prescribe lotions, as they can hardly fail to reach the seat of disease. Ung. hydr. nitratis, ung. hydr. nitrico-oxydi, and ung. zinci oxydi, sufficiently diluted with ung. cetacei, or fresh lard, are the best ointments. The acetate of lead may be used as a lotion, in the proportion of from two to four grains to the ounce of distilled water. [The yellow oxide of mercury ointment, gr. j to ʒj, or stronger in very chronic cases, is a useful application. Cod-liver oil and iron are generally required. Nitrate of silver—gr. ij to x to ʒj—should be applied to the edges of the lids two or three times a week.]

The worst forms of lippitudo may often be greatly relieved by slitting up the canaliculi in the manner described at page 153. By this means the overflow of tears is checked, and this of itself is an immense comfort to the patient; while at the same time the tendency to ectropion, which long-continued lippitudo often induces, is considerably diminished.

Phtheiriasis.—Among the irritable conditions of the eyelids, I may here notice that arising from the presence of lice. These creatures are "crab-lice" (*phthirius*), a species quite distinct from that which infests the scalp (*pediculus*). They thrust their heads into the skin at the roots of the cilia, and by means of the sharp claws with which all their legs, except the first pair, are provided, hold on so firmly, that they cannot be dislodged without great difficulty.

Phtheiriasis of the eyelids is an extremely rare affection, at least in this country, and I have met with only three or four instances, all of which occurred in children. On superficial examination, the cases are very similar to those of tinea ciliaris. The eyelashes present a powdery appearance, and their roots seem to be clogged with yellowish-gray and brown crusts; but by careful scrutiny of these supposed crusts, the movements of the insects may be detected; and the powdery appearance of the cilia is owing to their being clogged with the exuviæ of the creatures, and dried sanies from the wounds they have inflicted. The insects may speedily be destroyed by thoroughly smearing into the roots of the eyelashes the white precipitate ointment (ung. hydrarg. ammonio-chloridi).

MORBID GROWTHS OF THE LIDS.

The following are the more common swellings which appear in or upon the lids:

Cysts, of two distinct kinds. Those of the first kind, extremely common, are met with both in the upper and the lower lid (*Encysted tarsal tumor*, Tyrrell; *Chalazion*, Mackenzie); the others are found almost invariably at one spot, namely, just over the external angular process of the frontal bone, to the periosteum of which they are attached.

Molluscum is met with on the lids of children, and seems identical with the little masses termed by Tyrrell "glandiform," and by Mackenzie "albuminous" tumors.

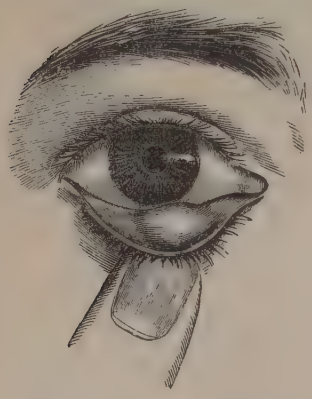
Warts are sometimes found on the lids, differing in no respect from those on other parts of the body.

Nævi materni, resembling those of other parts.

1. *Cysts* of the lids are met with at all ages. They may exist singly, or several may appear together, coming successively to their full growth. The skin over them is quite unchanged, so that, when small, they are hardly recognizable except by the touch. They feel like half a hempseed or half a pea fixed by the flat side to the tarsal cartilage, and presenting a convexity towards the skin, which may be freely moved over them. They rarely exceed the size of a pea, except when suppuration has taken place within them.

If the lid be everted, the position of the cyst is recognized by a thinning of the tarsal cartilage, forming a dusky spot, around which the conjunctiva is reddened [Fig 279]. These cysts may remain of a moderate size during life, without causing any inconvenience; but sometimes they suddenly inflame and become enlarged, the skin over them reddens and at last gives way, a small quantity of pus escapes, and afterwards a thin sanies continues to ooze from the aperture. But more commonly the pus makes its way through the palpebral conjunctiva, and then a little red fungous mass gradually protrudes, which, by the continual pressure of the eyeball, becomes flattened out into a mushroom shape.

[Fig. 279.



Exposing a tarsal cyst (Wells).]

When these cysts are so small as to escape ordinary observation, they require no treatment; but if they become so large as to be unsightly, and, still more, if they inflame and suppurate, they must be treated in the following way. The lid being everted, a crucial wound is made through the conjunctiva into the cavity of the cyst. If the inflammation has been acute, pus escapes, otherwise a little serum. A scooped probe passed into the cavity, and twirled about in various directions, brings out the accumulated epithelium, which has a jelly-like appearance. Blood then fills the cyst, and makes it as large as it was before the incision. The patient, however, may be assured that this swelling will gradually subside. To prevent premature closing of the wound, and refilling of the cyst, the probe should be used in the way just described every third day for about a fortnight. The walls of the cyst come together, and ultimately form a slight thickening in the lid, just perceptible by the finger applied to the skin. [Many surgeons prefer to dissect out the cyst wall through an incision of the skin.]

Fibrous cysts, varying in size from that of a large pea to that of a hazel-nut, and containing sebaceous matter and hairs, are almost invariably confined to one situation, namely, just over the external angular process of the frontal bone. They appear to be congenital; at least, I have seen them of considerable size in infants four or five months old. The skin over the cyst retains its natural appearance, and it is only on account of the unsightliness that the surgeon is consulted.

In dissecting out the cyst, which is the only mode of treatment, great care is requisite to avoid cutting into it: and especially while the cyst is being separated from the periosteum, to which it always adheres pretty closely. The cavity is lined by a smooth membrane, and is filled with white greasy material interspersed with loose hairs. In a cyst removed by one of my colleagues from an infant five months old, these hairs were still growing from the lining membrane. It seems that, in the course of years, these hairs may attain a considerable size, while the fatty material degenerates into oil. Such was the case in a very large cyst which I removed from a woman between thirty and forty. The skin had become so much thinned as to have assumed a dusky hue; and in endeavoring to dissect out the cyst I punctured it, and there escaped a quantity of perfectly clear yellow oil. There remained within the cavity only some detached black hairs, loosely curled together, and as strong as those of the head.

2. The little masses described by Tyrrell as "glandiform tumors" appear to be identical with *molluscum*, which attacks children in the form of small, white, rounded bodies, scattered over the lids, the alæ nasi, and about the corners of the mouth. When very small, these bodies are slightly reddish; but when as large as a pea, they are white, and exhibit at the apex a minute opening through which a milky fluid exudes on pressure. The readiest way to get rid of these unsightly masses is to split them all through with a lancet, and then to nip out with the nails

the contents of each. The mass, when pressed out, looks almost like a fragment of parotid gland.

3. *Warts* may be snipped off with scissors, the little wound being touched with nitrate of silver; or they may be tied at the base with a fine silk, and allowed to slough.

4. *Nævi* of the lids differ in no respect from those met with in other parts of the body; but they require more careful and discriminating treatment, on account of the importance of avoiding, as much as possible, any considerable loss of skin; a large cicatrix being not only in itself unsightly, but likely, by its contraction, to cause distortion of the lid. Subcutaneous ligature, therefore, or the introduction of probes coated with fused nitrate of silver, must be preferred to including any portions of skin within a ligature, or extensively destroying it with escharotics.

I have seen injections of alum cause sloughing of the lids and great subsequent deformity; and such a result might follow the injection of any similar fluid into the loose areolar tissue of the part, unless some contrivance can be used to restrain the fluid within proper limits.

In the following case an injection of tannin proved successful:—

A young lady was brought to me with a nævus on the upper lid, the size of a small hazel-nut. I was informed it had already been twice operated on by the introduction of threads steeped in nitric acid, and much inflammation and sloughing had ensued, as was proved by a considerable cicatrix of the skin near the outer canthus. The apex of the swelling was on the free margin of the lid, on everting which, a small bunch of veins, about the size of a barley-corn, was seen projecting through the tarsal cartilage, only covered by conjunctiva. The nævus seemed to be formed almost wholly by veins, the larger trunks of which could be felt through the skin, as they emerged below the superciliary ridge.

Having inclosed the whole upper lid in a "ring forceps," I could completely isolate the nævus from its parent veins, and I then punctured it with a very small narrow knife (Hays's needle-knife), and cut up its tissue subcutaneously. Being emptied of its blood, the nævus collapsed; and I next, with a fine syringe, threw in a few drops of a saturated solution of tannic acid. After a short pause, I relaxed the pressure of the ring forceps, and so allowed the returning blood to mingle with the injected fluid.

The subsequent inflammation produced a good deal of swelling and hardness of the lid; but the only slough was a mass about the size of a small pea, which made its way out at the little wound. The final result was complete obliteration of the nævus.

Carcinoma rarely commences in the lids, although it may spread to them from other parts. Should it be already far advanced when first brought under the surgeon's notice, extirpation would hardly be attempted. Small, hard, suspicious growths at the margin of the tarsus may be removed by excising a wedge-shaped portion of the lid on which they grow, and then uniting the wound with sutures.

Epithelial cancer chiefly attacks the skin over the lacrymal sac, and from that point extends over the nasal and superior maxillary bones, having the appearance of a shallow pale ulcer, with an irregular outline and uneven borders, and with a scarcely perceptible quantity of secretion. Chloride of zinc, made into a paste, and applied over the entire surface of the sore, so as to include its edges, will sometimes very effectually destroy the morbid growth, and it may be reapplied whenever any part of the border of the sore begins to exhibit fresh activity. Of course, the strictest attention to general health would be combined with the local treatment.

[Chloro-acetic acid is a very efficient caustic, when frequently applied, and is almost painless.]

INJURIES OF THE LIDS.

Ecchymosis.—An effusion of blood into the areolar tissue of the lids, popularly termed "a black eye," is commonly the result of a blow, but it may arise from other causes, as, for instance, from the unskilful employment of leeches. The sufferer is always most anxious to get rid of the ecchymosis as quickly as possible; and I know of no treatment so efficacious as that handed down by the traditions of pugilism, consisting in the application of a poultice formed of the freshly-scraped root of the "black bryony" (*tamus communis*), mixed with a due proportion of linseed-meal or bread-crumbs. Poultices of this kind produce a stinging sensation in the skin, and, if regularly applied, for a day or two, seldom fail in effecting a complete absorption of the effused blood.

Emphysema.—This, like ecchymosis, is usually the result of a blow with the fist, which fractures some of the thin brittle bones, such as the lacrymal or ethmoid, forming the inner wall of the orbit. If, shortly after such an injury, the patient blows his nose, the eyelids suddenly puff up, so that he is unable to separate them. On pressing the part with the fingers, we at once perceive the peculiar crackling caused by the presence of air in the areolar tissue. If the patient abstain from blowing his nose, the effused air soon becomes dispersed, and the swelling disappears.

Wounds of the lids have already been considered.[1] They are to be treated on the common principles of surgery which apply to other regions. The careful surgeon would naturally be alive to the importance of obtaining the nicest adaptation of cut surfaces in parts so open to observation. The yielding nature of the skin of the lids, and its plentiful supply of blood, offer peculiar facilities for effecting close and smooth union of wounds by means of fine sutures, in applying which the greatest care must be taken to avoid any irregularity and puckering of the cut edges.

CHAPTER XIII.

DISEASES OF STRUCTURES WITHIN THE ORBIT.

Structures very dissimilar, as regards their nature and functions, are grouped together in the present chapter; but they are all more or less concerned in supporting or imparting motion to the eyeball. The various morbid growths within the orbit, which cause displacement or impair the mobility of the organ, are also here briefly noticed.

PROTRUSION OF THE EYEBALL.

(*Proptosis oculi; Ophthalmo-ptosis; Exophthalmos.*)

Various causes may induce an unnatural prominence of the eyeball; but cases are sometimes met with in which this prominence seems of itself to form the whole morbid condition. The eyes have a remarkably staring expression, and look as if they were much too large for their sockets. The tarsi can be brought into contact; the eyes themselves move freely in all directions, and sight is unaffected. The equal amount of prominence in both eyes, and their unimpaired functions, at once remove any suspicion of orbital tumor.

Women of feeble and hysterical constitution, and those affected with bronchocele [exophthalmic goitre], are the usual subjects of this deformity, the cause of which is very obscure. Atony of the recti muscles has been suggested; and no doubt a weakened state of these muscles might produce a certain amount of prominence of the eye, but would be incompatible with its free motion. [Hyperæmia and hypertrophy of the orbital cellular tissue is generally admitted to be the cause of the exophthalmos.] I have never seen any cure or benefit result from treatment in these cases of proptosis.

Dislocation of the eyeball from the socket is an accident we often hear of, but I need hardly say, that without rupture of the optic nerve the eye cannot be thrust upon the cheek, where it so often figures in the exaggerated accounts of patients. What really takes place is, probably, the lodgment of the upper lid behind the greatest convexity of the globe. I have seen this accident occur, when a surgeon, anxious to explore the upper surface of the sclerotic, in search of a foreign body, or for some other cause, has too forcibly thrust back the upper lid. The tarsus, being forced beyond the summit of the eyeball, has suddenly slipped backwards, and become fast locked behind it. A wire elevator or a bent probe will enable the surgeon to lift up the tarsus and restore it to its place.

Hydatids, cancerous growths, and exostoses, by encroaching upon the cavity of the orbit, all give rise to gradual displacement of the eyeball. As this displacement increases, the movements of the eyeball become more and more limited, until at last it remains quite fixed.

It requires much careful investigation into the history of the case to enable the surgeon to determine the nature of the morbid growth. Exostoses are the slowest, and encephaloid tumors the most rapid in their progress. It is sometimes possible to pass in the tip of the little finger between the globe and the anterior edge of the orbit, and thus partially to explore the surface of the tumor. Hydatid cysts are recognized by a feeling of elasticity and fluctuation; and in doubtful cases a puncture with a fine trocar will sometimes reveal the true nature of the mass.

The removal of morbid growths from the orbit requires the utmost care, to avoid inflicting injury upon the eye itself or the optic nerve; and, before attempting such an operation, the surgeon should be well convinced that the mass is limited to the orbit, and has not extended into it from the cavity of the skull.

Abscess in the orbit occurs as a result of injury, such as the entrance of a foreign body; or it sometimes seems to be the effect of a chill. In a less acute form we meet with it as a sequela of fever and erysipelas. The suppuration is ushered in with rigors and depression; the conjunctiva and areolar tissue of the globe are red and infiltrated, the lids swollen and

[1] See Injuries of the Face.

livid; the eyeball becomes prominent and immovable; and at length fluctuation can be detected by the finger passed in between the lids and the globe. The rapidity with which these symptoms follow each other would serve to distinguish suppuration from the growth of a tumor. Until fluctuation occurs, the existence of pus in the areolar tissue of the orbit is very obscure; and the deep exploratory punctures which some surgical writers advise to be made between the eyelids and the globe must be very unsafe, considering how closely the eyeball is surrounded with muscles and nerves, which random incisions would endanger. A careful surgeon may sometimes succeed in safely opening a deep orbital abscess; but I have known a total division of the optic nerve to result from an over-bold incision.

Chronic abscess in the orbit is commonly the result of caries or necrosis; and the denuded bone will be felt by introducing a probe through the opening by which the pus has been evacuated.

Orbital abscess, even of the acute and so-called phlegmonous kind, so commonly occurs in depressed and feeble subjects, that light and nutritious diet, with a due proportion of stimulants, will be indicated instead of abstinence and leeches. The bowels should be rapidly unloaded, and then narcotics given in doses just sufficient to soothe pain and induce sleep. Bark and ammonia, wine and other tonics, will often be needed in increased quantities during the free suppuration, which not uncommonly follows the opening of the abscess. Warm water-dressing will be throughout the best local application.

[An interesting and important class of cases, which has given rise to much discussion, is that formerly known as "orbital aneurism," but now usually designated by the more indefinite and comprehensive term of pulsating exophthalmos, or vascular protrusion of the eyeball. Numerous post-mortem examinations have shown that all the symptoms of supposed orbital aneurism—protrusion, pulsation, bruit, etc.—may be caused by disease existing behind the orbit and obstructing the return of blood through the ophthalmic vein.[1]]

AFFECTIONS OF ORBITAL NERVES.

The eyeball and its appendages derive their sensibility from branches of the ophthalmic division of the *fifth* nerve, which not only endows these parts with feeling, but also so far influences their blood supply that total anæsthesia of the nerve is followed, sooner or later, by deranged nutrition of the cornea, and by other phenomena generally described as "inflammatory."

These phenomena have been already noticed in the chapter treating of Diseases of the Cornea; and at present we may confine our attention to those motory nerves which supply the muscles of the lids and globe,—namely, the third, fourth, sixth, and "portio dura" of the seventh, or facial.

The orbicularis palpebrarum is supplied by the last-named nerve, and when this is paralyzed, the tarsi can no longer be brought into contact. If the patient is told to shut the eye, the lids remain immovable, if the paralysis is complete; or if it be only partial, a slight attempt at closure takes place. [Lagophthalmus.] At the same time the eyeball is rolled upwards by the action of the superior rectus, as if seeking in that way the shelter of the upper lid. Sometimes the branch supplying the orbicularis palpebrarum is alone paralyzed, but more frequently this is affected in common with the other facial muscles.

The orbital nerves, it will be remembered, are distributed as follows: the third to the levator palpebræ, the superior, inferior, and internal recti, and inferior oblique muscles; and also to the iris, through the medium of the ophthalmic ganglion. The fourth nerve supplies the superior oblique, and the sixth the external rectus.

It is not necessary that all the muscles supplied by one of these nerves should be affected at the same time, or to the same extent; but for the sake of illustration we will assume cases in which the various nerves have wholly lost their motory function.

The following are the symptoms of paralysis of the *third* nerve. The upper lid hangs motionless, and is in contact with the lower one (*ptosis*). On lifting it we find the globe abducted, so that the cornea is turned towards the temple. The patient can direct the eye still farther outwards, but neither inwards, upwards, nor downwards. The pupil is dilated and fixed, and on that account vision, especially for near objects, is somewhat impaired, although the optic nerve and retina may be wholly unaffected. By looking through a small aperture vision becomes perfect. [The impairment of vision for near objects is due to paralysis of the muscle of accommodation (ciliary muscle), which is supplied by a branch of the third nerve.] If the patient looks with both eyes at objects placed on that side of him towards which the affected eye is abducted, they appear single; while

[1 See Trans. Am. Ophthalmological Society, 1875.]

objects in the other direction appear double. If all the branches of the third nerve are paralyzed, the inferior oblique muscle of course ceases to act, and the superior oblique, having no antagonist, rotates the globe on its antero-posterior axis, and hence vertical objects seen with the affected eye appear oblique.

If the *sixth* nerve alone be paralyzed, the eye is turned inwards. This inversion can be increased at will, and the eye can be freely moved upwards and downwards; the pupil is of natural size and active, and the upper lid retains its motions unimpaired. If the patient looks at objects on that side towards which the eye is inverted, they appear single; but objects in the other direction are double.

Paralysis of the *fourth* nerve is much less common than either of the two forms already mentioned, and on account of the very slight change it causes in the position of the eye, is very difficult of detection. The paralysis is chiefly to be recognized by its subjective phenomena. If, for instance, the patient with both eyes open fixes his attention on some straight line on the ground, as the edge of a gravel-walk, or the curbstone of a foot-pavement, he sees two lines, one in its real position, and the other forming with it a more or less acute angle. If with both eyes he looks at a near object, such as a large capital letter, at such an angle that it appears double, the image perceived by the affected eye will incline from the perpendicular, and its lines cannot be brought parallel to those seen by the sound eye, unless the patient inclines his head to one side. The letter T or a +, as containing right angles, are good forms for testing the defect.[1]

The *treatment* of paralytic affections of the orbital nerves must be based on a careful investigation into the symptoms of each individual case, for the causes of paralysis may be very various. Slow, and eventually total, paralysis of one or all the nerves which enter the orbit may depend upon chronic changes in the brain itself, or in the dura mater, the growth of tumors, disease of bone, etc. Sudden paralysis may follow apoplectic effusion or other injury to the cerebral structure, or may depend upon rheumatic inflammation of the fibrous tissues immediately surrounding and investing the nervous trunks.

Of course the prognosis would vary greatly accordingly as one or another of these causes had induced the paralysis. In the case of chronic brain-disease, or the growth of intracranial tumors, the treatment could be only palliative. The probability of recovery in cases of apoplexy would depend upon the extent of the extravasation.

If one or more of the orbital nerves were suddenly paralyzed, and at the same time other parts of the body were affected with loss of motory power, while the brain itself gave evidences of its whole circulation being disturbed,—there would be comparatively little chance of the orbital muscles recovering their function. But if the paralysis were so completely limited to one of the orbital nerves as to render it probable that only some minute vessel in the course of the motor tract had given way, and had involved the adjacent brain-fibres, the absence of all other cerebral symptoms would warrant the hope that considerable improvement, or even complete recovery, might take place.

By far the most hopeful cases are those where the paralysis of the orbital nerve can be traced to rheumatism; since a well-directed treatment of the general rheumatic diathesis will, in all probability, restore the affected nerve to a healthy condition.

[Syphilis is one of the most frequent causes of paralysis of the orbital nerves, and a large proportion of such cases may be successfully treated.]

This seems to be the most fitting place for saying a few words about the affection termed *Mydriasis;* for although its manifestation is wholly in the iris, yet the morbid appearance is caused by a loss of motory power in certain branches of the third nerve.

In Mydriasis the pupil is dilated and immovable; and as such a condition is attended with some indistinctness of sight, it often gives rise to extreme alarm, and is regarded as a symptom of "Amaurosis." A simple experiment, however, suffices to determine the real nature of the case. Let the patient supply the want of a contracted iris by looking through a small aperture, such as a pinhole in a card held close to the eye. If the case be one of *Mydriasis*—dilated pupil, with a sound retina—he will see perfectly; but if the retina be affected, the aperture will either be quite useless, or at the utmost, afford very little assistance.

[The ciliary muscle is usually, although not invariably, paralyzed at the same time with the sphincter of the iris. This will impair near vision in the emmetropic eye, and distant vision also in the hypermetropic. Each can be restored by the proper convex glass. The stenopæic hole improves vision by admitting only the central rays, and shutting out the peripheral, which cause most of the confusion

[1] The use of the oblique muscles appears to be to maintain the eyeballs in such a position that their vertical diameters may be always kept parallel to each other during lateral inclination of the head.

in the retinal image when the eye is not properly focused. Simple mydriasis would not very markedly impair either distant or near vision.]

The *treatment* of Mydriasis is not easily reduced to precise rules, as the affection may originate in various ways. Exhaustion of nervous energy, dyspepsia, intestinal irritation from worms, etc., rheumatism—all seem in turn to be the exciting cause. Tonics, alone or in combination with purgatives, colchicum, strychnine, as an internal medicine, or applied "endermically," powdered ergot of rye, snuffed up the nostril of the affected side,—all these and other means have been employed with but little success. The discovery of the remarkable property of the Calabar bean has at once placed at our command a substance which induces contraction of the pupil as completely as atropine dilates it; but I have not met with a case of true mydriasis in which the Calabar bean, however efficacious at the time, has produced a permanent cure. It is best used by means of little discs of gelatine, on the principle invented by Streatfeild for the application of atropine.

A very contracted and immovable state of the pupil is described by some writers under the name *Myosis*, but is seldom met with as a simple and independent affection. Some persons who have naturally very small pupillary apertures enjoy such excellent sight that we must be cautious how we call such a state of the pupils morbid. Extreme contraction of the pupil, however, is a symptom of irritation of the sympathetic nerve; and it would therefore induce the surgeon carefully to examine the condition of this nerve in the neck, as being possibly pressed upon and irritated by some tumor or morbid growth.

STRABISMUS.

The various forms of mal-position of the eyeball just noticed, depending upon more or less sudden paralysis of the ocular muscles, might, according to strict etymology, be classed under *strabismus;* but, practically, the term is restricted to those chronic cases in which habitual mal-position results from irregular action of either the internal or external rectus. The deformity may be defined as a faulty position of the eyes, whereby a separate [different] image falls upon each macula lutea, when the patient endeavors to direct both eyes to one object at the same time.

[It is a matter of great importance to distinguish between true strabismus and paralysis of the muscles of the ball. The diagnosis is not always easy in cases of partial paralysis. In true strabismus there is little or no limitation in the movements of the deviating eye when the other one is covered; and the secondary deviation is equal to the primary. By secondary deviation is meant the associated movement of the sound eye when it is excluded from vision, and the object is fixed by the strabismic eye. If, in a case of internal strabismus of the left eye, the right is excluded by a screen, and the left is directed towards an object held in front of it, the right will be inverted to the same extent that the left was—the angle of deviation will remain the same. Hence the term *concomitant strabismus*. If, on the contrary, the inversion of the left eye is due to paresis of its external rectus, the innervation expended in the effort to abduct it will cause a more extensive associated movement inward of the sound eye.]

Strabismus may be either *convergent* or *divergent*. In the former case the eye, or eyes, will be directed towards the nose: in the latter case towards the temple. The strabismus is termed "single" if one eye only is misplaced, and "double" when both eyes converge or diverge. In many cases which ordinarily appear as double strabismus, one eye becomes perfectly straight whenever the patient fixes his attention on an object; and the eye which thus for a time acquires a normal position will be found to have the stronger powers of vision.

[True strabismus never occurs in both eyes at the same time unless, in consequence of some complication, the patient does not fix with his macula. Usually one eye deviates constantly, while the other is properly directed, and the deviating eye eventually becomes highly amblyopic from suppression of its retinal image, or "psychical exclusion," to avoid diplopia. In exceptional cases, the strabismus is *alternating*, and the patient may have the power of using either eye at will. In such cases, the vision remains unimpaired in both eyes.

In the early stage of hypermetropic strabismus, which is due to excessive convergence associated with the excessive accommodation required to overcome the optical defect, the inversion is usually *periodic*, and occurs only when accurate vision is demanded, particularly for near objects. In this stage the squint may be cured by the use of proper glasses. If the patient is too young to wear glasses, the loss of vision of either eye may be prevented by occasionally applying atropia to the unaffected eye, and thus compelling the use of the other. The case is, in this way, converted into one of alternating strabismus.]

In other instances of double strabismus both eyes maintain their inverted position,

even while the patient is intently observing an object; but if the surgeon suddenly closes one of these convergent eyes, the other at once becomes straight, resuming its inversion as soon as the other eye is opened.

Donders has shown that in the great majority of instances convergent strabismus is associated with hypermetropia; and the divergent form with myopia. Divergent strabismus however is rare, except as a consequence of considerable loss of sight in one eye, persisting for several years.

The *causes* of strabismus are very various. When existing only to a slight degree, coming on only occasionally, and alternating from one eye to the other, it will sometimes be found due to intestinal irritation, such as that arising from worms. In other cases, it may be traced to the temporary cerebral disturbance induced by teething, or to the more persistent form which attends hydrocephalus. An opacity near the centre of the cornea will sometimes cause an eye gradually to turn inwards through a sort of instinctive effort of the organ to bring a clear portion of the cornea into use.

[In a very large proportion of cases, the cause is to be found in defective refraction.]

The *treatment* of strabismus, as will be evident from what I have just said as to its causes, must vary according to circumstances. The removal of intestinal irritation; the use of tonics; the employment of convex glasses, to correct extreme hypermetropia;—these, and many other means, may be useful to control strabismus which is only temporary, or which arises from peculiarity in the visual focus of the eyes. In every case a careful ophthalmoscopic examination is the first duty of the surgeon; and he should also take every possible care to ascertain that no organic disease exists in the brain or orbital nerves, and that there is no tumor in the orbit mechanically hindering the movements of the eye.

The *operation* for the cure of strabismus consists in the division of the muscle, which, in consequence of shortening, or too great preponderance in contractile power, is permanently drawing the eye either inwards or outwards. Division of the internal rectus, when first introduced, was performed in the following way. The lids being held apart by an assistant, a small sharp hook was stuck into the sclerotic, close to the inner margin of the cornea, so as to fix the eyeball and draw it outwards. Then the surgeon, raising with a forceps a fold of conjunctiva midway between the cornea and plica semilunaris, divided it vertically with scissors, snipped through the sub-conjunctival tissue covering the tendon of the muscle, passed under it a blunt hook or director, and upon this divided with scissors, or with some kind of knife, either the tendon itself or the adjacent muscular portion of the rectus internus.

As in all other instances of manual surgery, the apparatus for performing this operation gradually became simplified. The spring speculum superseded the elevators held by an assistant; the sharp hook for fixing the globe was laid aside; and it was found that all the cutting could be done with scissors alone. The curious little knives, in every variety of form, which had been invented for dividing the muscle, are now for the most part forgotten; as are also the unseemly disputes about priority in trifling discoveries, and the exaggerated accounts of the uniform success which was stated to have attended the practice of certain strabismus operators.

The defects of this earliest form of operation were a too great separation of the ocular conjunctiva, inducing a subsequent retraction of the semilunar fold, and an over weakening, amounting sometimes to utter loss of action, in the divided muscle.

We still occasionally meet with a fixed and leering eye which recalls the period of the first introduction of the operation in 1840; when, without the ophthalmoscope to facilitate diagnosis, every tyro fancied himself competent to cure a squint.

The deformity arising from retraction of the semilunar fold is now in a great measure obviated by sub-conjunctival division of the muscle. The lids are kept asunder with a spring speculum; and an assistant draws aside the globe, by nipping up with the forceps a little fold of loose conjunctiva near the margin of the cornea, at the opposite side to that on which the muscle is to be divided. Supposing the internal rectus to be chosen for operation, the surgeon, with scissors, divides the ocular conjunctiva horizontally, on a level with the lower edge of the cornea, and extends the incision towards the semilunar fold. Then he snips through the sub-conjunctival tissue, and having clearly exposed the sclerotic, slides upwards, between it and the rectus, a curved director. This serves to raise the muscle and make its fibres tense, and then with scissors the muscle is carefully cut through, close to its insertion into the sclerotic. This section of the muscle cannot be completed at a single stroke, but requires repeated use of the scissors, so that no fibres may be left undivided.

While this sub-conjunctival operation through a horizontal external wound obviates the retraction of the semilunar

fold, it involves the risk of an imperfect division of the muscle, which is not exposed to the view of the surgeon. A careful exploration with the blunt hook or director must be made to detect any undivided fibres, before the spring speculum is finally withdrawn.

Graefe divides the conjunctiva a little below the equator of the globe and a few lines from the cornea, almost over the insertion of the tendon; exposes the sclerotic just enough to pass a curved blunt hook beneath the tendon, which is drawn well into the conjunctival wound before using the scissors. It is then snipped through close to its sclerotic attachment; care being taken that the hook, which is sharply curved, is not allowed to perforate the tendon, but is passed well under it. In this operation the tendon is brought quite into view, and is not likely to escape division, which is one of the dangers of the sub-conjunctival operation.

In dividing the *external* rectus, it must be borne in mind that the muscle is broader than the internal rectus, and is also inserted farther from the corneal margin.

Most cases of strabismus require the division of each internal rectus, even when the inversion of the better eye is but slight in comparison with the other. Instances, however, occur in which the inversion is wholly confined to one eye; and in such a case the faulty eye may alone be operated upon.

[When there is an inversion of more than three lines, it is generally necessary to operate on both eyes. Except in extreme cases, however, it is not well to operate on both at the same time, but to regulate the second operation by the permanent effect produced by the first. In all cases the refraction should be carefully tested, and corrected by glasses if found defective; otherwise the squint is likely to be reproduced by the continuance of its original cause.]

No absolute rule can be laid down as to the use of chloroform [or ether] in strabismus operations. In most cases it will be found necessary; but where patients are fitted by age, intelligence, and self-command to undergo the operation without it, the doubt which sometimes exists as to whether the muscle has been effectually divided can be at once solved, by directing the patient to attempt inversion of the eye; a test we are unable to employ when insensibility has been induced.

When, in searching for the muscle, the sub-conjunctival areolar tissue has been largely separated, it becomes infiltrated with blood, and forms a little prominence in the wound. The blinking of the lids gradually moulds this into a small button-shaped excrescence, attached by a narrow pedicle, which may be snipped through some weeks after the operation.

[*Insufficiency of the internal recti and divergent strabismus* usually depend upon myopia. With normal eyes the act of near vision consists in the convergence of the visual axis to a near point, and the accommodation of the focus of the eyes to the same point. The first is accomplished by the internal recti muscles, and the second by the ciliary, and there is a nicely balanced co-ordination of these muscles. In hypermetropia a degree of accommodation in excess of convergence is required, and convergent strabismus frequently results, while in myopia the excess of convergence over accommodation promotes external strabismus. Even without strabismus, asthenopia (weak sight) may be caused by fatigue of the overworked internal recti muscles, just as in hypermetropia it results from the excessive demand made upon the ciliary. The latter is called "accommodative asthenopia," and the former "muscular asthenopia," or "insufficiency of the internal recti." Either may occur without any error of refraction, as a symptom of muscular weakness after severe illness, exhaustion from overwork, or nervous disturbance; and these are frequently exciting causes when the anatomical conditions exist in the hypermetropic or myopic form of the eye.

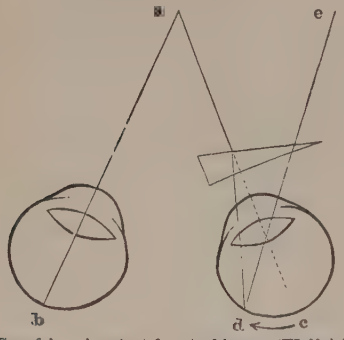
A patient with insufficiency of the internal recti may be able to read perfectly well for a time, but soon experiences a sense of fatigue, a burning sensation in the eyes, and, perhaps, pain in the ball and brow, and finally the print becomes dim and confused, and the letters overlap each other, or "run together," from a tendency to diplopia, and reading becomes impossible. Sometimes, on looking up from the book, distant objects, as a light across the room, appear double or to have double edges. If the insufficiency is of high degree, one internal rectus will give out, and the eye will diverge, and by closing that eye the patient may be able to continue his work. In very high degrees of myopia this is often the only practicable solution of the difficulty, and the patient must resign himself to the use of one eye only, with the chance of a permanent divergent strabismus of the other. The tendency in all cases is to the production of a permanent squint; but this deformity is not the only result to be dreaded, as the strain of muscular asthenopia is a very important factor in the increase of short sight in cases of "progressive myopia," and should receive the most anxious attention.

The diagnosis is easy enough in decided cases. The nature of the trouble may

reveal itself by a divergence of one eye in reading, of which the patient is himself conscious; but this is usually prevented by the unconscious efforts to fuse the two retinal images in binocular vision. To exclude this effort, the patient should be directed to look at a small object, as the point of a pencil, held about six inches from the eyes, while the surgeon places his hand in front of one eye. The excluded eye will diverge, and, on removing the hand, will be noticed to make another movement back to its former position of fixation.

A more delicate test is the prism test of Graefe. A prism refracts the rays of light passing through it towards its base, and when held in front of the eye removes the retinal image in that direction from the macula, causing diplopia. The eye will then attempt to fuse the double images by moving in such a direction as to bring the macula to the new position of the image. In Fig. 280 the prism removes the image from the macula at *c*

Fig. 280.



Graefe's prism-test for strabismus (Wells).]

to *d*, and it is projected outwards to *e*, instead of to *a*. Stimulated by the desire for binocular single vision, the eye makes an outward movement to bring the macula from *c* to *d*.

The strongest prism that can be "overcome" in this way is the measure of the strength of the opposing muscle, *i. e.*, the muscle towards which the angle of the prism is directed. The internal recti are the strongest, and can usually overcome a prism of 20° or 30° or more, the measure of the external rectus is about 8°, while the superior and inferior cannot generally go beyond 2°, though, in exceptional cases, they may be found much stronger, particularly the inferior. If a prism of 10° be placed before one eye base down, binocular single vision will be rendered impossible, and there will be vertical diplopia. If the balance of the internal and external recti is normal, one image will stand directly above the other; but if there is insufficiency of the internal recti, there will be a movement of one eye outwards, causing also a lateral separation of the images. The measure of the insufficiency is the strength of the prism which, placed before the eye with its base inwards, brings the two images to the same vertical line.

The best test object for distance is a candle flame; that commonly used for near is the dot-and-line test of Graefe (Fig. 281). It is held at the reading distance, and the

Fig. 281.

Graefe's dot-and-line test (Wells).]

patient is directed to look steadily at the dot, the two images of which will appear on the same line if the action of the muscles is normal; but there will be two parallel lines if the action of the internal is deficient. The line should be lighter than represented in the figure, as there is sometimes an effort to fuse its images. If this is suspected the line may be dispensed with.

The treatment of these cases offers one of the nicest practical problems of ophthalmic surgery. No definite rule can be laid down applicable to all cases, but each must be made a special and careful study. In young subjects with sound eyes and strong accommodative power, the asthenopia may often be relieved by full correction of the myopia; that is, by putting the ciliary muscle to work and establishing the proper relation between accommodation and convergence. In the case of older persons with a far point of twelve or sixteen inches, the prism that corrects the insufficiency, divided between the two eyes, may be prescribed for reading. In higher degrees of myopia a partial correction, placing the far point at fourteen or sixteen inches, is sometimes sufficient; or if a degree of insufficiency still remains,

it may be corrected by combining the proper prisms with the concave glasses. If all these expedients fail, the question of dividing the external rectus arises. This may be done with safety if there is decided divergence on attempting to fix an object at the reading distance, but in other cases there is danger of producing an internal strabismus and an annoying diplopia for distance. For a further discussion of this subject, the reader must be referred to special works on ophthalmic surgery.]

REMOVAL OF THE EYEBALL.

Certain diseased conditions of the globe may require a portion of it to be removed, while in other cases its tissues may be so extensively involved, and so much constitutional disturbance may in consequence arise, as to render necessary the total extirpation of the whole organ.

In non-malignant cases this operation is usually undertaken with a prospect of the patient afterwards wearing an artificial eye; and it therefore becomes important to consider whether a total or partial extirpation will be best adapted to the end in view.

The enlargements which call for removal, on account of the deformity they occasion, are chiefly staphylomatous projections of the cornea or the sclerotic. Under the former term are commonly included projections which have really little or no corneal tissue within them, being formed of the iris coated over with fibrous tissue, after the true cornea has been partially or wholly destroyed by ulceration or sloughing. The sclerotic staphylomata, as they are called, are produced by gradual thinning and distension of the weakened fibres of the part from accumulation of aqueous humor or of serum. In some of the latter cases the eyeball acquires a very large size, and is extremely unsightly, on account of the dark leaden-colored projections of the sclerotic, and the large tortuous veins which ramify over it. When the cornea has been extensively destroyed by sloughing or ulceration, it very commonly happens that the lens escapes through the breach; when this does not take place, the lens frequently becomes filled with a deposit of phosphate of lime, and this earthy mass, by pressing against the ciliary processes and iris, often causes severe neuralgia. In excising a staphyloma, therefore, the opening should be made sufficiently large to allow the lens, if still existing, to escape.

In operating, the lids must be held apart with a spring speculum or the fingers of an assistant. The surgeon then passes a cataract-knife through the staphyloma, and forms a flap, which he seizes with a forceps, and removes with a second stroke of the knife; if the lens presents at the opening, it is to be quickly tilted out with a scoop, and then the lids are instantly to be closed, and a cold sponge applied firmly over them. This immediate pressure is the most likely means for preventing hemorrhage from the enlarged choroidal vessels, which sometimes give way the moment the fluid contents of the globe have escaped. Moderate pressure should be kept up until the risk of bleeding has gone by, and then water-dressing will be the only application required till the parts are healed. The portion of the globe left after the excision of a staphyloma gradually shrinks to a nodule, and as soon as this has ceased to be tender, an artificial eye may be applied. [The incisions should be made far enough back to include the ciliary region in the portion removed.]

If, in consequence of the sudden removal of the pressure which the accumulated fluids of the globe had been exerting on the choroidal and retinal vessels, the latter give way, and blood fills and distends the cavity of the sclerotic, extreme pain is the result, and it may even be thought desirable at once to extirpate all that remains of the globe, with the view of preventing future suffering. With the object of obtaining a better stump on which to wear an artificial eye, Critchett has modified the operation for staphyloma as follows. He passes several curved needles armed with threads through the sclerotic, above the base of the staphyloma, quite into the vitreous chamber, and brings out their points at the opposite side of the projection. He then cuts away an elliptical portion from the front of the mass, draws the ligatures quite through, and ties them in knots, which then lie just across the line of the closed incision.[1]

Total extirpation of the eyeball.—This operation, except when malignant disease exists, should never be resorted to, so long as any sight remains in the organ; unless it should be so irritable as to lead the surgeon to fear that, by sparing it, the sight of the fellow-eye may be endangered. Restricted within due limits, and not undertaken through a morbid love of operating, extirpation of the eyeball is a ready means of relieving patients whose whole system may have become impaired by long-continued neuralgia, arising from distension of the globe, or from lodgment of foreign bodies within its cavity.

[The extirpation of an eyeball is most frequently required for the cure or prevention of sympathetic disease of the other eye. A useless eye in which there is any

[1] Ophthalmic Hospital Reports, vol. iv., p. 1.

continuous pain, irritability, or tenderness, should never be allowed to remain, as its fellow is always in danger. Sympathetic ophthalmia often occurs many years after the original injury or disease. When an eye has been subjected to extensive injury, involving the ciliary region, or when a foreign body is lodged within it, it is safer to extirpate at once, as when sympathetic ophthalmia is once established, it is not likely to be controlled by extirpation of the injured eye. The operation may be considered a measure of prevention rather than of cure.]

The operation, which was formerly effected by scooping out all the contents of the orbit, has been greatly simplified by the adoption of Bonnet's method, in which the globe alone is removed. A circular incision is made through the conjunctiva and ocular fascia, and then each muscle of the eyeball is successively divided close to its insertion, and the optic nerve just before it pierces the sclerotic.

The operation is usually performed by raising with a hook all the tendons of the ocular muscles, and dividing them before cutting through the optic nerve.

I prefer the following plan, as simpler and more rapid. Having inserted the spring speculum between the lids, and made with curved scissors the usual circular incision of the conjunctiva, I grasp the external rectus and its surrounding tissue with a forceps, and snip them through; an assistant at once seizes the cut tendon close to its insertion, and draws the eye inwards. By sliding one blade of the scissors under the superior oblique and rectus muscle, they can be divided, and then the inferior rectus; the optic nerve is next snipped through, and the globe starts forward. A few strokes of the scissors divide the inferior oblique, internal rectus, vessels, and bands of areolar tissue, and the operation is completed. Cold water and exposure to the air suffice to arrest the bleeding, and then water-dressing is all that is required.

USE OF CHLOROFORM [OR ETHER] IN OPHTHALMIC SURGERY.

We may regard chloroform under two aspects: as saving the patient from pain, and as facilitating the manipulation of the surgeon. Now it is well known that operations performed on the globe itself cause little pain, and last but a very short time. Those on the lids, involving as they do the wounding of skin, are of course more painful; but none of them are in this respect comparable to the larger operations of general surgery; and there are few adults who, if properly informed as to the real nature of such operations as those for cataract, artificial pupil, and strabismus, will not readily undergo them without the aid of anæsthetics. There are, however, many timid and anxious persons who are quite unable to go through the operations for artificial pupil and strabismus except under chloroform, and very few without its aid can encounter extirpation of the eyeball. It is also occasionally necessary to induce insensibility in order to examine eyes rendered irritable by disease, or by the presence of foreign bodies. In children all ophthalmic operations are greatly facilitated by the use of chloroform, and some can hardly be performed without it.

If a perfectly passive condition of the eye is so desirable during the delicate operation of flap-extraction, one would naturally expect to find chloroform peculiarly indicated in such a case. But it forms, I think, a special exception, for the following reasons. We have already seen (p. 131) that, when this operation of extraction has been properly performed, a successful result chiefly depends upon the rapidity with which union of the corneal wound can be effected. Now, with every precaution in the administration of chloroform, it will occasionally induce sickness; and the effort of vomiting may cause the vitreous body to escape through the opening just made in the cornea, thus inducing prolapsus iridis, with all its consequent irritation and hindrance to union of the wound. But, even without assuming so extreme a case, we shall find a very serious objection to chloroform in the nausea and disrelish for food which often follow its inhalation, whereby the nutrition and reparative power of the cornea become impaired during the critical twenty-four hours immediately succeeding the operation.

[In this country at least, when anæsthesia is required in operations on the eye, ether is almost universally preferred to chloroform, on account of its greater safety.]

[DESCRIPTION OF PLATES.[1]

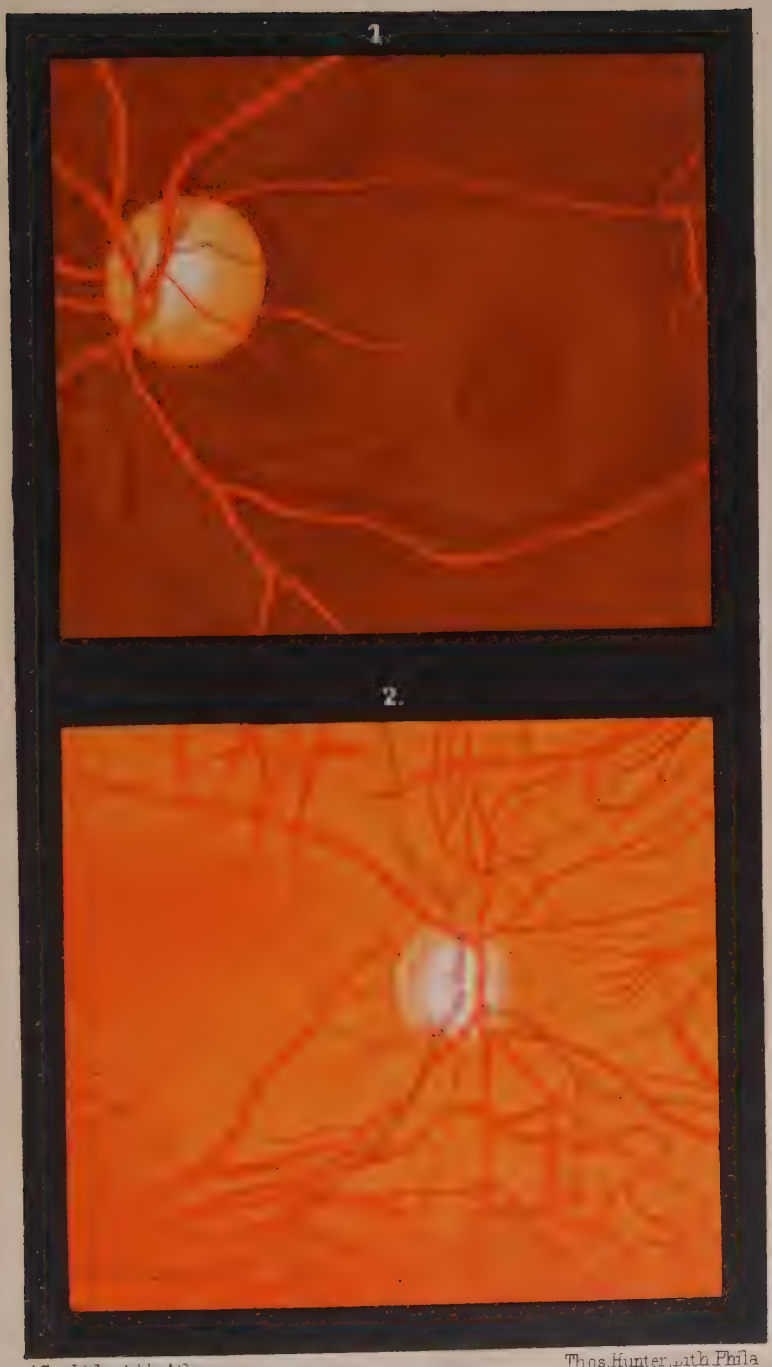
PLATE X.

Normal Fundus Oculi.

Fig. 1 is taken from a brunette, and shows a rather deep pigmentation of the fundus. The fine dots over the field represent the pigment epithelium. The paler vessels are the retinal arteries, and the darker ones the veins. The dark spot to the right and slightly below (the

[1] Plates from Liebreich's Atlas have been substituted for those used by the Author.

Plate X.



After Liebreich's Atlas.

Thos. Hunter, lith. Phila.

Plate XI.

After Liebreich's Atlas.

Thos. Hunter, Lith. Phila.

Plate XII.

After Liebreich's Atlas.

Thos. Hunter, Lith. Phila.

image is inverted in the figure) the disc is the macula lutea, and the small dot in its centre, is the fovea centralis. The choroidal vessels are entirely concealed by the density of pigment in the epithelium.

Fig. 2 is from a light blonde, and is slightly pigmented. The color of the fundus is of a much brighter red, and the choroidal vessels can be seen through the epithelium.

Plate XI.

Fig. 1 shows the peculiar pigment spots, and the atrophy of the retina and optic disc found in *Retinitis pigmentosa*.

Fig. 2 shows the grayish cloudiness of the disc, the white opaque zone, the spots at the macula, the engorged veins, and the hemorrhages of highly developed "Retinitis albuminurica."

Plate XII.

Figs. 1 and 2 are representations of atrophy of the optic nerve: Fig. 1 of the blue atrophy, with "stippling" of the disc (rather too pronounced) due to unnatural distinctness of the lamina cribrosa, which is frequently found in connection with disease of the spine; Fig. 2 of the white atrophy of cerebral amaurosis.

Fig. 3 represents a case of "choked disc," as met with in cerebral or orbital tumor. The disc is swollen and striated, and its boundary obliterated, and the retinal veins are engorged.

Fig. 4 gives a view of the same case as in Fig. 3, but two years later, when consecutive atrophy had supervened.

Figs. 5 and 6 show the cupping of the optic disc in glaucoma. In Fig. 5 the progress of the disease has been arrested by iridectomy; in Fig. 6 it has progressed to deeper cupping and complete atrophy. The cupping is shown by the interruption in the course of the vessels as they pass over the edge of the disc.]

DISEASES OF THE EAR.

By James Hinton, Esq.

Revised by Charles H. Burnett, M.D.

The diseases of the ear naturally divide themselves into three classes, in conformity with the anatomical structure of the organ—those of the external, of the middle, and of the internal ear. The first class includes the affections of the auricle and of the external meatus; the second, those of the membrana tympani, tympanum, mastoid cells, and Eustachian tube, with the adjacent regions of the throat; the third embraces the diseases of the labyrinth and of the auditory nervous apparatus, so far as it comes within the reach of our investigation. In addition to these, certain diseases not capable of strict local definition, and the effects produced upon the brain and other organs, chiefly the lungs, by inflammation commencing within the ear, will require description.

I. Affections of the External Ear.

Auricle.

Malformations.—The surgeon is occasionally consulted for external malformations of the ear. These vary in extent from an entire absence of the meatus and its appendages on the one hand, to the presence of a double set of organs on the other. The most frequent malformation is an imperfect development of the meatus and auricle; the former being reduced to a narrow slit in the temporal bone, and

the latter existing only as a slight fold of the integument. The tympanum also, in some of these cases, is merely rudimentary, consisting of an irregular aperture a few lines in diameter, and the ossicula are more or less defective. Sometimes a single bone, resembling the columella of birds and reptiles, takes their place. The labyrinth is in these cases most frequently normal, and a certain amount of hearing is usually present; often it is so considerable as to enable the patients to perform useful duties. For the most part extensive deformity is present, from absence or defect of other portions of the skull, as the malar bone, or the zygoma; and the orifice of the meatus may seem to lie very much anterior to its normal position. Operative proceedings have not been found beneficial in these cases, nor in those in which, with a more or less perfectly formed auricle, the cartilaginous portion of the meatus is also perfect but ends in a cul-de-sac. The bone beneath is generally found solid. In another class of cases, however, in which the defect is confined to a contraction of the meatus at its orifice, from a falling back of the tragus, or projection forwards of the antitragus, efficient assistance can be rendered by the prolonged use of a tube adapted to the size of the canal; or excision of a portion of the offending cartilage. Congenital closure of the meatus by a false membrane, sometimes superficial, sometimes deeply seated, near the membrana tympani, is said to have occurred, and to have been remedied by the division of the structure, followed by the introduction of tents.

Supernumerary auricles are sometimes met with, growing from the sides of the neck.

In the ninth volume of the Transactions of the Pathological Society, Mr. Birkett relates a case of this kind. The structures consisted partly of a tissue like the lobe of the ear, and partly of fibro-cartilage, the shape of which "resembled more or less closely, in parts, that of the proper auricle; and its tissues were the same." They were excised without difficulty, and appeared to be merely cutaneous appendages, not extending more deeply than the fibres of the platysma myoides.

[*Congenital fistula auris.*—This not uncommon malformation or arrest of development consists in a dimple or fistulous opening in front of the tragus, in the helix, or just in front of it above the tragus and also in the concha. The fistula may extend as far as the tympanic cavity. Such malformations may present themselves on both sides of the head, and in connection with defects in the throat. The cause is said to be an arrest of development in the first visceral cleft. Sometimes retention-cysts form at the opening of the fistula near the external ear; these may be best treated by ablation. Simple, uncomplicated cases of congenital fistula auris require no treatment.]

Injuries of the auricle, and the lodgment of foreign bodies in the meatus, will be found treated of in the essay on INJURIES OF THE FACE.

The auricle is subject to various *cutaneous affections*, herpes, impetigo, pemphigus; but the most important are chronic erysipelas and chronic eczema. Both these conditions are most frequent in women past middle age, though the latter is also met with in children. In chronic erysipelas the entire auricle becomes greatly thickened, so that its outline is almost lost. The skin is red, dry, and hard, and covered with desquamating epidermis. The swelling encroaches on the meatus, the orifice of which is narrowed and frequently obstructed with epidermis. There is constant itching, but not much pain, though the parts are tender. Sometimes the affection dates from a previous attack of acute erysipelas, extending over the side of the head; sometimes it seems to be local from the first. The health is invariably deranged. The *treatment* consists first in cleanliness, the discontinuance of wrappings, and free exposure of the parts to the air. When the inflammatory thickening and irritation are considerable, poultices may be applied at night. A continued use of astringent lotions is needed to restore the healthy action of the skin. A solution of nitrate of silver (gr. v.—℈j to ʒj), used alternately with others, has considerable effect. Glycerine is often very soothing; or the ear may be covered with collodion, renewed daily. The constitutional treatment should be conducted on the usual principles. Debility is generally, but by no means always present. A permanent contraction of the meatus sometimes results from this disease. Its effects may be mitigated by wearing a small silver tube accurately fitted to the parts.

In chronic eczema the auricle presents less thickening than in the last-mentioned affection; but it is considerably swollen, covered more or less with brown or yellow crusts, and, when these are not present, exudes a watery fluid. A similar eruption is generally present on the scalp, or on other parts of the body. The diseased condition mostly extends into the meatus, and more or less deafness is present. It is attended with great itching. The membrane is generally somewhat reddened and swollen. The *treatment* is the same as for other forms of eczema; but the meatus should be well syringed out with warm water frequently, to pre-

vent discharge from accumulating within it, and in the later stages of the disease may be washed with a solution of the nitrate of silver, or with citrine ointment diluted with glycerine or almond oil. If, after the eruption has ceased, there remain any degree of hardness of hearing, dependent upon a thickening of the membrana tympani, the case would come within another class of affections—those of the middle ear.

Gouty deposits are met with in the auricle; and congestion of the cartilage, arising from the same cause, is sometimes met with. Excoriations are not uncommon in children; but they are readily cured by cleanliness, with or without mild astringent lotions. Great care should be taken to dry the ears and hair of children after washing. In inflammatory affections of the auricle or meatus the glands beneath the angle of the jaw generally become somewhat swollen and tender; occasionally suppuration occurs in them. Paralysis of the facial nerve may result from their pressure.

[Among cutaneous diseases affecting the external ear, especially the auricle, may be mentioned erythema, intertrigo, frost-bite, chronic inflammation of the skin, and acne. Among more serious forms of skin disease attacking the ear may be cited lupus erythematosus, lupus vulgaris, psoriasis, ichthyosis, comedo, keloid, molluscum fibrosum, with the disease elsewhere on the body, and ringworm. Phagedena or cancrum auris, gangrene from embolism, and gangrene of the auricles in low fevers may be mentioned as uncommon, as well as cornu cutaneum auriculæ, and idiopathic herpes zoster. The latter may be seated in the auricle, or the tragus, or in the auditory canal. Secondary syphilitic eruptions are also found on the auricle, and tubercular syphiloderm.

In regard to the treatment of these diseases of the ear, reference should be made to the standard works on diseases of the skin; but a caution is given here not to allow the remedies applied to the auricle and auditory canal to run down the canal to the membrana tympani, for as a rule, if they are allowed thus to escape from their proper point of application, damage to the drum membrane is inevitable.]

Tumors of the auricle.—Of these, three chief forms have been described:—

1. A fibrous growth of great hardness, forming in the cartilaginous portion, and giving rise sometimes to great inconvenience. [The author has confused the situation of these tumors in the auricle. The fibrous tumor here alluded to is not found in the cartilage of the auricle.] This is rare in England, but in the American Journal of Medical Sciences for October, 1860, it is stated to be much more common in negroes. Fibrous tumors also form in the lobe, around the hole from which the ear-ring is suspended. In either case they are easily removed.

2. Cystic disease. Under this name two distinct affections have been described: one consisting of a sac containing a glairy tenacious substance, the other being an infiltration of the tissues of the auricle with a sanguinolent fluid. The latter is the disease met with so frequently in the insane, known under the name of hæmatoma auris. Whether this affection arises from injury is still a matter of discussion among those who have charge of the insane. For treatment, Dr. Thurnam (as quoted by Mr. Toynbee) recommends, in the acute stage, "the use of evaporating lotions; at the end of a week or two a seton should be passed through the long axis of the swelling, and the contents pressed out. Under the use of the seton the tumor gradually subsides." In the treatment of the ordinary cysts Mr. Wilde recommends that they should be laid freely open, and dressed from the bottom with lint.

3. Steatomatous and fatty tumors are also met with in the auricle, as well as a pendulous state of the lobe, which may reach an extreme degree, especially if goitre be present. This part is also subject to nævus, which may lead to its destruction to a greater or less extent; and erectile tumors have been met with in it, causing hemorrhage. For the treatment of the latter affection, reference may be made to the section on VASCULAR TUMORS, in vol. i., p. 271.

[There are other morbid growths on the auricle which demand attention, such as sarcoma, glandular hypertrophy, epithelial cancer, and othæmatoma, both in the sane and insane. Epithelial cancer is the only malignant disease which occurs primarily in the auricle. The only beneficial treatment of epithelioma of the auricle is immediate excision of the growth, even if to do this amputation of the entire pinna is necessary. Healing may be slow, and if the auricle has been cut off near the skull, the granulations must be prevented from closing the external meatus. This is best done by keeping some form of tent in the opening of the auditory canal, and by destruction of the granulations with caustics. If the cancerous disease has not extended into the meatus and to the drum, the treatment will be successful.

Othæmatoma in the sane.—Some instances of so-called spontaneous othæmatoma in the sane have been recorded; but in most such cases the cause can be traced to some traumatic influence, as boxing, assaults on the ear, burns, scalds, and

exposure to intense cold. The clearly traumatic cases have been termed spurious othæmatoma, to distinguish the disease from the variety which may be regarded as symptomatic of approaching insanity. Traumatic othæmatoma is mostly observed in males, though Dr. C. J. Blake reports one of a female thirty years old, who, in falling, had struck her ear.

The diagnosis will not be difficult, as the history and general condition of the patient will plainly indicate the traumatic origin of this variety of blood-tumor. Most of the symptoms are sthenic, whereas the asthenic and indolent character of the tumor in the insane is marked, and hence distinctive.

Treatment.—The treatment of traumatic othæmatoma should consist in opening the sac if suppuration has taken place. But if the latter process shall not have taken place, the symptoms of heat, congestion, swelling, and pain must be combated as in the idiopathic variety, viz., by application of ice and iodine. If it be necessary to open the sac to evacuate the pus which may have formed, the cavity should be gently stimulated by injections of weak solutions of carbolic or salicylic acid, and the walls kept in contact by gentle compression. With proper management the auricle can be kept from great deformity.

In the treatment of either form of othæmatoma the chief endeavor must be to alleviate pain and prevent subsequent deformity of the auricle. The surgeon must be guided in all cases by the form of the disease, for it is manifest that surgical treatment is undesirable in the idiopathic form, in the insane, while it may be demanded in the traumatic, or even the idiopathic form, should it appear in the sane. Should the distension in either form become painful, it will become advisable to puncture the tumor. Opinions, however, are divided as to what is the best treatment, even among those who have had the widest experience. Hun, Kirkbride, and Worthington, whose experience in this disease among the insane has been vast, are opposed to opening the sac; while Gruber, Joffe, and Schlager, in Germany, and Roosa, in America, are in favor of early operation in all forms of the disease. After the sac has been emptied, pressure should be applied to insure union in the walls of the cavity which contained the blood. If the latter is still fluid, a trocar may be used; but if it be coagulated, the clot must be removed through a wider incision. Thickening of the auricle, and the consequent deformity, may be lessened or removed by painting with tincture of iodine. Rau[1] recommended, at the beginning of the disease, until the tumor begins to soften a little, cold lead-water dressings; then these are to be removed, and warm fomentations of arnica may be employed to favor resolution and absorption.

[1 Ohrenheilkunde. Berlin, 1856, p. 170.]

Injuries of the Auricle.

Traumatic cleft of the lobule.—An earring is sometimes torn from the ear, thus leaving a slit in the lobule. In order to prevent an unsightly and permanent slit, healing by first intention must be aimed at.

The general surgeon is often called on to treat a variety of wounds of the auricle. The treatment must consist in adjusting the wounded and displaced parts, keeping them in position by a stiff dressing, and subsequent attention according to the general principles of surgery.]

Affections of the External Meatus.

In some cases in which this passage is wide and short, the greater part of it and the membrana tympani can be examined, by placing the patient in a good light, and gently elevating the helix with one hand, while the tragus is drawn forward with the other. For the most part, however, this is not possible, and a speculum is necessary. The best form is a silver tube, of oval shape to fit the meatus, with its smaller end continued of the same diameter for about half an inch. This instrument, of which it is desirable to possess different sizes, admits the largest possible amount of light, and adapts itself easily and painlessly to the canal, in which it will remain fixed while the surgeon's hands are free. By moving it slightly in different directions, the inner part of the meatus and the membrana tympani can be examined. A very good view may be obtained by causing the rays of the sun to fall through this speculum into the meatus, which may be effected by placing the patient in the sunlight, with his head inclined at a suitable angle; but, as a rule, it is better to use a reflector, and employ the diffused daylight. If artificial illumination is necessary, it may be supplied either by means of a jet of gas conveyed by a flexible tube to a small stand furnished with a reflector, or by a reflector attached to an ordinary candle, or by the lamp invented by Dr. Chowne, and known as Miller's lamp. In using the speculum, the curve of the meatus forward should be remembered. In young children the meatus is very shallow, the osseous portion consist-

ing only of a small rim of bone (deficient at the upper part), to which the membrana tympani is attached in a very horizontal direction. The speculum, therefore, should be used in their case with great caution. The points to be noted

[Fig. 282.

Von Troeltsch's aural mirror.]

in the examination of the meatus are, the size and calibre of the canal, whether normal or infringed upon; the presence or absence of extraneous bodies and of cerumen; and the condition of the lining membrane. [It would be correct to say the lining skin and not membrane, for there is no mucous membrane in the auditory canal.]

[*Examination of the Ear.*—At present aurists find that all which is necessary as a reflector of light with which to examine the auditory meatus and membrana tympani, is the instrument known as Von Troeltsch's aural mirror, and a set of different sized aural specula, or funnels, as they are more properly called in Germany; and the best pattern will be found to be

Fig. 283.

Gruber's specula.

those named Gruber's specula. A section of these specula will be found to be ovoid in shape. In day time the bright daylight from the north may be used—direct sun-rays will burn—or the light from an Argand gas-burner. The latter is used almost entirely by aurists nowadays on account of its great convenience and constant accessibility. For bed-side illumination, if the above mirror and specula are used, an ordinary candle will do perfectly well if the examiner knows how to catch the light and manipulate the instruments. A variety of other kinds of instruments are used to examine the ear, but they are employed with advantage only by those who have had considerable experience. For these more complicated forms of examination the reader is referred to the standard works on the ear and its diseases.]

Accumulation of cerumen. — The presence of wax appears to be only in a minority of instances the sole cause of the deafness that accompanies it. Mr. Toynbee found a perfect restoration of hearing effected by the removal of cerumen in sixty ears only out of 165.

Besides interfering with the hearing, accumulations of hardened wax may produce various ill effects. They may occasion (probably through pressure on the membrana tympani and ossicula) very distressing nervous symptoms; not only "noises in the head" of various kinds, but giddiness, confusion, and even unsteadiness of gait, exciting the gravest apprehensions in the patient's mind. Further than this, they may even cause absorption of the bony walls of the meatus. This occurs especially in the old, in whom neglected accumulations have existed for many years. In some cases of this kind the osseous plate that separates the cavity of the meatus from that of the mastoid cells is completely penetrated.

Deafness caused by cerumen for the most part presents peculiar symptoms, and a tolerably good diagnosis may often be based on the history of the case. The hearing generally varies; it is often better in the morning, or is improved by eating, or by rubbing the meatus with the finger. Very often it comes on suddenly, especially after exposure to cold. This is probably due to slight inflammatory swelling taking place in the meatus, and converting a partial into a complete occlusion. This circumstance has frequently led to the employment of the most misplaced depletory and other treatment in cases in which an inspection of the meatus has not been made. There is, however, another form of deafness which comes on suddenly after exposure to severe or long-continued cold, or cold and wet, and appears to depend upon an abolition of the function of the nervous apparatus. The great degree of the deafness, however, compared with the slightness of the apparent cause, together with the previous history, may serve to distinguish the effect of cerumen from the last named affection. But it should be needless to remark that no treatment for any aural affection should be undertaken till a complete examination of the meatus has been

made. If cerumen be present, it is best removed by syringing. The most efficient form of syringe is one fitted with a separate nozzle of small size, since a small jet of water acts more effectively, and presents less obstruction to the returning stream. The nozzle should be taken off each time the syringe is filled. [The editor has not found the removal of the nozzle at all necessary and would suggest that it will be found very inconvenient to do it.] If this form of syringe is not used, care must be taken that the meatus is not obstructed by the instrument. In syringing, the meatus should be straightened, by drawing back the auricle with the left hand, and gently pressing forward the tragus by resting the nozzle of the syringe upon it; my own practice is to direct the stream along the roof of the meatus. Care should be taken that the fluid is of the right temperature; it should never be below that of full blood heat. If too cool or too hot giddiness is produced. In ordinary cases warm water only need be used. The use of the syringe should never be carried beyond a moderate extent at any one time, and should be discontinued if the patient complains of pain. It is much better to repeat the process several times than to run any risk of producing irritation, the effects of which are sometimes very difficult to allay. Cases occur in which the most distressing and obstinate noises in the ears have supervened upon the removal of wax by the syringe; and in some of these I have found that even the most gentle employment of that instrument tends to aggravate the symptoms. If the wax is not removed in a moderate time, warm oil or solution of soda for a few nights will generally sufficiently soften it. This, however, is not always the case; sometimes the altered cerumen, mingled as it is with epidermis, is of almost stony hardness, and the parts at the same time are acutely tender, so that the most prolonged and gentle treatment is necessary to give relief. The ear should be frequently examined with the speculum, to ascertain whether any wax remains; since although the last portion generally comes away in a large mass, presenting a cast of the membrana tympani, this is not always the case. Small masses of hard cerumen sometimes collect in contact with the membrana tympani, and occasion much annoyance, in the form of itching and tinnitus. The speculum reveals the nature of the case, and syringing, which sometimes needs to be repeated, relieves it. A similar irritation may follow from the falling in of a hair upon the membrane; but probably in these cases there already exists a morbid irritability of the organ.

After the removal of cerumen, the membrana tympani is generally seen to be of a more or less sodden and opaque appearance, from thickening of its epidermoid layer; sometimes it is red and vascular. In many cases the hearing only gradually returns; and sometimes, when the immediate improvement has been but slight, it will rise by degrees almost to its normal amount. Time should therefore be allowed for this result before other measures are adopted. This affection is apt to return; nor have I seen sufficient evidence to show that applications to the meatus can ward it off.

[The editor feels justified in saying that cerumen does not accumulate in the auditory canal, unless it is packed there by undue efforts at cleansing on the part of the patient. If the ear is let alone in this respect and washing it confined to the concha, all superfluous wax will roll out in the form of little balls. All that remains smeared around the opening of the meatus should be allowed to stay there.]

Besides accumulation, the secretion of wax is subject to other disorders. In children it may become increased in quantity, fluid, and offensive; this being often the first stage of catarrhal inflammation of the meatus. In adults it is frequently entirely absent; but this is for the most part merely a concomitant of internal morbid conditions, and is itself entirely without influence on the function of the ear. Sometimes, though not always, the reappearance of the normal secretion attends or prognosticates a favorable issue of the case.

In the majority of the cases in which accumulations of wax are found, there exists also a *desquamation of the epidermis*, and it is not uncommon to remove large masses of the latter, more or less mingled with cerumen. Sometimes an obstinate tendency to desquamation exists without any other apparent affection of the meatus, and this may or may not be accompanied by disease of the internal or middle ear. It may occur in connection with a general morbid irritability of the organ, or with tinnitus; and in the latter case the irritation of the loose masses of cuticle may aggravate the noises to a most distressing degree. The treatment in such cases must embrace the improvement of the general health and the strengthening of the nervous system. Local applications require to be very carefully employed. The ordinary astringents are ill borne. In this respect the condition differs from the common chronic inflammation of the meatus. A few drops of oil applied occasionally facilitate the removal of the flakes.

An enormous amount of injury is done by well-meaning nurses, who think the

ears of children require to be cleared out by inserting into them the screwed-up corner of a towel. Dense masses of mingled secretion and epidermis become thus pressed down upon the membrane and often fatally injure it. I question indeed, whether this practice may not rank next to scarlatina among the causes of diseases of the ear in children.

As long ago as 1844, Mayer reported a case of vegetable parasite in the external meatus, and recently, among others, Dr. Wreden has directed much attention to this subject.[1] The presence of the parasite is indicated by the production of dense white flakes within the meatus, which are obstinately reproduced. The membrane has never been found perforated, and no discharge is present. The growths hitherto met with appear to belong to Aspergillus and Ascophora, and both filaments and spores have been met with in great abundance. Dr. Wreden recommends as the best application a solution of hypochlorate of lime, from one to two grains to the ounce. It should be pure and freshly dissolved in water. Liquor plumbi in moderate solutions has also been found successful. I believe the affection is more common on the Continent than in England.

[*Laminated Epithelial Bodies.* — Sometimes there is found in the external auditory canal a large accumulation of epithelium, arranged in layers. This seems to be made up of successive exfoliations of epithelium from the skin covering the wall of the bony portion of the auditory canal. Its etiology is obscure. In some cases it seems that the patient is to blame for its formation by too much picking at and cleansing the ear. This latter manipulation, usually done with the curled-up corner of a soft towel or wash-rag, gradually packs in the naturally thrown off pieces of epithelium, until the mouth of the canal is blocked up. The natural process of extrusion of the exfoliated epithelium, which goes on in the healthy and unobstructed ear is thus stopped, the successive layers of epithelium are kept in the canal, until the plug is formed, and hardness of hearing may be the result. These plugs are very horny and strongly adherent. Wreden has proposed the name of Keratosis Obturans for the affection.

Treatment.—Many forms of treatment have been proposed for the removal of these obstructions. The most efficient, gentlest, and safest plan will be to soften the mass by instillations of the following solution:—

℞. Sodæ bicarb., gr. x.
Glycerinæ, f℥j.
Aquæ, f℥vij. M.

Five to ten drops of this may be instilled, two or three times daily, into the meatus by the patient, and the surgeon should every day gently syringe the ear and remove all he can by this means.

At best it will require several days or a week to remove one of these plugs from the ear. If the surgeon possesses the requisite instruments and the skill, he may illuminate the external ear, by the forehead mirror, and then most cautiously pick away the nearest and central layers of the plug, with delicate, long-bladed forceps. But this must be done with great care, even by one with special skill, lest the walls of the auditory canal be wounded.

After the nearest parts of the plug have been removed, an attempt may be made by syringing to force enough warm water behind the plug to remove it.

In some cases the walls of the auditory canal will be found very red, but unless irritants have been previously poured into the ear, no disease of the skin of the canal will be found.

Ingrowing and loose hair from the tragus. —Hair on the tragus may grow inwards and irritate the auditory canal, and it is said by some observers that these hairs may reach the membrana tympani, and give rise to disagreeable scraping sounds whenever the jaw is moved. I have frequently taken from the ear loose tragus hairs, which had been pushed into the canal and down on the drum, where they caused like annoyance.

Epilation, or a good trimming of these stiff hairs in the first place, and removal by syringing or delicate forceps in the latter instance, will be found to give entire relief.

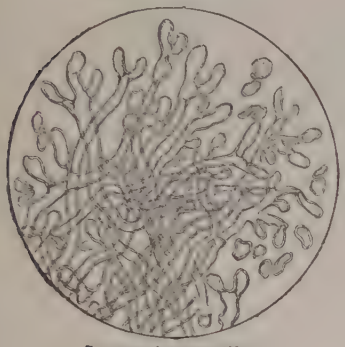
Aspergillus in the ear.—This fungus, the aspergillus, is found in two varieties in the ear of living man, viz., the A. nigricans, and the A. glaucus. Its tendency is to seek the deepest parts of the fundus of the auditory canal; and hence, as a rule, it begins to grow upon the membrana tympani. This it inflames on its outer dermoid layer, and forming as it were a false membrane, spreads over the entire drum membrane, and the sides of the auditory canal, producing as it goes an otitis externa diffusa. The symptoms are at first an itching and burning deep in the ear, with a sensation of fulness. To these earlier symptoms are soon added hardness of hearing, tinnitus aurium, pain, and at last a watery discharge. Sometimes these symptoms are all slight,

[1] Wreden, Die Myringomykosis Aspergillina, St. Petersburg, 1868.

and when the discharge begins relief is felt. But in such cases a return of all the symptoms in an aggravated form is likely to be experienced in the course of twenty-four hours.

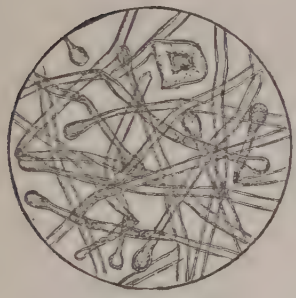
This fungus will grow in the tympanic cavity if the drum-membrane is perforated. It may attach itself to the membrana tympani, but it has not been shown that its growth on the latter leads to perforation of the membrane. Its nature is easily detected if a flake of the whitish substance, looking like wet paper, be subjected to the microscope.

Fig. 284.



Spores of Aspergillus.

Fig. 285.



Spores of Aspergillus.

Fig. 286.

A B. Fully developed fruit stalks of Aspergillus.
C. The spores being cast off from the ripe head.

The appearances then seen are represented in Figs. 284, 285, 286, drawn by the Editor. In Fig. 284 the earliest forms of the fungus are shown; in Fig. 285 a more advanced stage, and the fully developed fruit stalks are shown in Fig. 286. These features of the specimen may be rendered much more evident by putting a drop of liq. potassæ to it when mounting it for examination.

Treatment.—The best parasiticide in cases of aspergillus in the ear is undoubtedly alcohol. The affected ear should be filled up with alcohol three times a day, and the alcohol should be allowed to remain in the auditory canal, and in contact with the fungus, for five minutes at a time or even longer. This can be done if the skin of the canal is not greatly abraded by previous manipulations, or if it be not raw from eczematous inflammation. In the latter instances, only diluted alcohol can be used. Syringing should be done at least once daily, and by the physician rather than by the patient.

If the patient can use the alcohol as directed, and let the physician syringe the ear, once daily, what would otherwise be a very stubborn and annoying disease may soon be cured.

If eczema should complicate the case, as it not uncommonly does, it must be treated, as well as the inflammation caused by the fungus. The first consideration, however, is the destruction of the fungus, upon the presence of which the inflammation depends.

It is claimed that frequent syringing with warm water will rid the ear of this parasite. It is better, however, to use along with the syringing, a safe parasiticide, like alcohol, which will hasten the cure.

Seborrhœa.—Great annoyance is experienced by some patients from seborrhœa of the auditory meatus in the region of the wax glands, and even in parts of the concha. This disease is apparently very often caused by an improper hygiene of the ear. Under a false impression that the ear-wax should be scraped or wiped away, many individuals systematically do too much in cleansing the ear. This leads to irritation of the ear, for some wax in the meatus is necessary to the perfect health of the organ. Itching or burning is soon felt, and then more scratching is done, and very probably a variety of domestic remedies, as oils, fats, and a long list of matters, all of which are pernicious, are put into the ear. This leads in the course of a few months to a thickening of the skin and an altered secretion of the ceruminous and sebaceous glands. The former

are apt to cease secreting, and the latter seem to secrete abnormal quantities of a brittle sebum. This is often packed into flakes or balls by the patient's improper manipulation, and forced into the canal and moulded into "glove finger casts," leading to hardness of hearing and considerable distress.

After the auditory canal has been well cleansed, the membrana tympani will usually be found somewhat congested, but rarely diseased. The disease lies in the meatus, and here the remedies must be applied. The first step in the treatment is to urge the patient not to scratch nor even to touch the ear, except to gently wash the concha for purposes of ordinary cleanliness. At the outset it will be best for the surgeon to apply with a camel's-hair pencil, every two or three days, a little of the following ointment :—

℞. Hydrarg. ox. rubri, gr. iij.
Vaselini, ʒij. M.

If the physician cannot do this, let the patient be instructed to apply it, with a small hair-pencil, every other night or twice weekly, to the meatus ; and to avoid all other treatment, especially picking or swabbing the ear, and pouring anything into it. Remedies for diseases of the auditory canal, when poured into the meatus by the patient, rarely reach properly the affected part, but are more likely to fall upon the drum-membrane and inflame it.

The deafness in these cases is best relieved by the physician's careful removal of the scales of epithelium and secretion, which have formed into glove-finger casts, of the canal and drum-membrane. The internal administration of arsenic will hasten the cure.

Foreign bodies in the ear.—Foreign bodies, as found in the ear, may be divided into two general classes, viz., animate and inanimate. The former consist chiefly in small insects and their larvæ. All living insects in the ear cause great and peculiar distress to the patient on account of their movements, and if a fly remains in or about the meatus long enough to deposit eggs, the maggots, which soon develop, cause an intense anguish from their eating into the skin of the canal and the membrana tympani.

All insects can be stilled by a few drops of oil or even water, and they may then be syringed out or removed by forceps if they have become wedged in, as some of the roach-variety. Maggots, however, cannot be killed by any such mild means. A drop or two of ether or chloroform will kill them, and they must then be removed by forceps. Their peculiar tenacula enable them to hold to the tissues very strongly, even after death, and both care and some force are requisite to remove them from the fundus of the canal.

An inanimate foreign body in the ear may be, in fact generally is, a harmless thing if let alone. Most of the injuries said to be caused by inanimate foreign bodies in the ear are, in reality, due to ignorant, and hence very unskilful endeavors, to get them out.

Inanimate bodies are put into the ear both by adults and children ; by the former, for some mistaken purpose of cleanliness, by the latter, in play. The variety of such objects is vast, as beads, pins, beans, grains of the different cereals, etc. All of these, if not suddenly and forcibly jammed into the ear, will do no harm, certainly not at first, if let alone. They rarely impede the hearing, because the sound-waves can pass around them to the drum. But, unfortunately, as soon as it is announced that some such foreign body has got into the ear, scores of frightful tales are told to the victim, and as many foolish, and even dangerous, suggestions given for the removal of the foreign substance. Such foreign bodies cannot get into the drum-cavity or the brain, unless they are pushed there by some one's hand.

It should be laid down as a rule of general surgery that such bodies must be let alone, unless they can be removed without as much as even scratching any part of the ear, and also that no surgical instrument should be employed for their removal that is not guided by a most skilful hand under the brightest illumination from a forehead mirror. The ordinary armamentarium of the general surgeon contains no instrument fit to introduce into the auditory meatus, and with which to efficiently remove a foreign body, and it rarely contains the necessary adjuvant, a forehead-mirror. As any perfunctory insertion of an instrument and groping or probing about in the dark is absolutely sure to injure the ear, reliance is to be placed only on the use of the syringe and warm water, as it will prove itself both safe and efficient. Instruments made especially and properly for such purposes may be used by the special surgeon, but even he had better depend, at least at the outset, on syringing with warm water. Upon faithfully using this, the surgeon will rarely, if ever, be obliged to resort to other means. Buttons, beads, gravel-stones, etc., have thus been quickly and painlessly removed from the auditory canal after remaining days and even weeks in spite of many fruitless attempts to remove them by curettes, ear-forceps, wires, probes, and other more or less dangerous instruments. In fact, after an inanimate foreign substance gets into the ear, the future welfare of the organ is in the hands of the

first person who touches it thereafter. If he, in his ignorance or roughness, abrades the skin of the meatus and auditory canal, the swelling which ensues closes about the foreign body, and the latter then practically exercises pressure on delicate tissues, and inflammation of a severe character sets in. If rough manipulation is brought to bear on the foreign object it can easily be pushed through the membrana tympani into the drum-cavity. Here not only may it lead to loss of hearing, but should the inflammation spread from this point to the meninges, death is the result. In such cases the blame is laid on the foreign body; but, in justice, it should be attached to the improper treatment. If inflammation has been excited by rough treatment in the ear after a foreign body has got into it, no attempts at removal should be made until the inflammation and swelling are allayed; and this may require weeks.

Reflex phenomena caused by foreign bodies in the ear.—The presence of hardened cerumen or other foreign substances in the external auditory canal may be productive of reflex phenomena, as, for example, epileptiform symptoms, great tinnitus and vertigo, mistaken for Ménière's disease, and ear-cough.

All of these manifestations will prove very puzzling to the physician unless his attention be called to the ear, where the true seat of irritation lies. The fact that an inanimate object in the ear may produce these peculiar reflex symptoms forms the great reason for their early extraction, though, on the other hand, they may lie there for fifty years without exciting discomfort or annoyance.

In order to comprehend the peculiar reflex phenomena in these cases, it must be remembered that the ear is supplied by a filament from the pneumogastric nerve. Irritation from a foreign body, even from a lump of hard ear-wax, conveyed to this branch of the nerve, is reflected to the inferior cervical ganglion. The inhibitory power the latter exercises over the vertebral artery is overcome, and a congestion in the head, *i. e.*, in the internal ear, ensues, and dizziness results. The peculiar phenomena of lassitude, and even inability to use the arms, may be explained by the fact that irritation may be reflected from the pneumogastric nerve, through the inferior cervical ganglia, and to the axillary plexus, and a loss of power of controlling the calibre of the brachial vessels ensues, with consequent weakness in the arms.

Ear-cough is due to the irritation communicated through the aural branch of the pneumogastric nerve to the motor fibres of the superior laryngeal nerve. Instead of simply a cough, vomiting may ensue if the irritation is prolonged.]

Abscess in the meatus.—This is an acutely painful, though not otherwise serious affection. It occurs generally in persons about middle life, and consists in the formation of one or more small abscesses in the outer part of the meatus. The affection is apt to recur, and may coincide with the formation of boils in other parts of the body. While the abscess is forming, there is acute pain of a throbbing darting character in the meatus, often extending over the side of the head. The parts are extremely tender, and the attempt to introduce the speculum causes great distress. The hearing may be temporarily impaired by narrowing or closure of the canal. Incision is generally the best treatment; but relief is given by the free use of poultices and fomentations, which should be applied as hot as they can be borne. In almost all these cases a similar constitutional treatment is indicated as for "boils" on other parts of the body. When there has existed a tendency to their continued recurrence, the sesquioxide of iron in free doses has appeared to me to be useful.

[The editor would state here, once for all, that he is forced to discountenance the use of poultices over the ear, as they are just as likely to produce undue maceration, granulations, and sloughing here, as they are when placed over the eye.]

Inflammation of the meatus.—This affection is either acute or chronic; it is frequently connected with diseased conditions of other parts of the ear, the membrana tympani, tympanum, and mastoid cells: in fact a discharge from the meatus should always excite suspicion of disease of the lining of the tympanum: but it sometimes exists without the presence of more deeply-seated disease, especially in its earlier stages. Neglected inflammation of the meatus, aggravated as it constantly is by confined and decomposing discharges, has a great tendency to spread inwards, especially perhaps in children and among the poor.

The early symptoms are similar to those which characterize the formation of abcess. The pain, however, is generally less acute; it is of a dull aching character, and is increased by motion of the jaw. The meatus is tumefied, red, and tender. After repeated attacks, it may be so swollen as almost to obliterate the canal, but no local [outward] swelling is to be observed. The neighboring glands of the neck are often enlarged and tender. The hearing is not much impaired unless the canal is almost closed, or the tympanum implicated. The health is almost always

disordered, and some of the severest and most obstinate cases I have seen have occurred in patients subject to gout. The access of the disease is generally attributed to cold, or blows on the head may occasion it. Sometimes there occurs at an early period of the affection an extremely profuse watery discharge, almost equal to that which follows certain fractures of the skull; sometimes the inflammation subsides without any discharge; sometimes it is followed by a secretion of viscid mucus or of pus; or it may run into the chronic form of the disease.

In the *treatment*, the mere cleansing the meatus with warm water gives great relief, which is increased by hot fomentations and poultices, and it is probable that in some cases these means might suffice. The health, however, is generally more or less deranged, and the constitutional remedies either for debility or visceral derangement are indicated. Often also the severity of the pain demands local depletion, by leeches, around the orifice of the meatus (the passage being guarded by cotton-wool), and the employment of morphia in full doses to give rest.

After the inflammatory action has subsided, the ointment of the nitrate of mercury diluted with oil may be smeared over the surface of the meatus, or a solution of the nitrate of silver, five or ten grains to the ounce, applied with a camel's-hair brush. Care is needed to avoid a relapse.

A similar treatment is also often the most efficacious in the later stages of the *catarrhal* inflammation of the meatus, which is attended with more or less profuse semi-purulent discharge. But so far as I have observed, this condition is a concomitant of a similar affection of the tympanic cavity. Many cases also of apparent catarrh of the meatus are really cases of minute perforation of the membrane. In so far as the meatus is concerned, cleanliness is of course essential, and a mild use of astringents, with discontinuance (as a rule) of the use of cotton-wool are to be recommended. But syringing by the patient or his friends is seldom effective, and is very apt to become a source of irritation. It is better to fill the ear a few times with any lotion and let it run out after one or two minutes; or if a syringe be used, the best form is a glass tumbler, into the lower part of which a flexible tube is introduced, the stream being made to flow by raising the tumbler. But the cases are very few in which the chief treatment should not be directed to the tympanum or throat. For healing the irritable surface of the meatus I have known the blowing in of powdered talc succeed after the most various moist applications had failed. The health being almost always deranged, especially in children, tonics are indicated; quinine, iron, and cod-liver oil. Mr. C. Forster speaks very highly of the effects of chlorate of potash given in free doses.

Chronic inflammation of the meatus sometimes follows the acute form of the disease; sometimes it results from repeated slight attacks. A common cause is the habit of prolonged bathing, or damping without drying the ears or hair. Without any considerable amount of pain, a feeling of uneasiness in the passage is complained of, a sensation of tension, and often of itching, prompting the patient to introduce pins or other substances with the view of allaying the irritation. This practice of course maintains and aggravates the disease. The meatus is swollen, and the epidermis becomes thick and peels off, often accumulating to a great extent. Sometimes the entire cuticular lining of the canal becomes loosened, and may be withdrawn in a form resembling the finger of a glove, the inner extremity presenting an accurate cast of the membrana tympani. In the worst cases the walls of the meatus are of a dusky-red color beneath the epidermis, and tender. The wax is deficient, the hearing is most frequently impaired, and the membrana tympani vascular on its external surface. Indeed, this condition of the meatus seems seldom to exist without disease of the internal structures, the treatment of which is then of the primary importance.

Either of the above-described forms of inflammation may, in unhealthy subjects, extend to the osseous walls of the meatus, and give rise to caries or necrosis. This result is chiefly apt to occur in cachectic children.

Sometimes a considerable part of the walls of the meatus or of the mastoid process will come away; and it is remarkable to how great an extent this may take place without any considerable impairment of the functions of the ear. With the view of averting the extension of the disease inwards, the greatest care should be taken to secure a perfectly free exit for the discharge.

Syphilitic disease of the meatus.—This occurs chiefly in the form of fissures or of condylomata around the orifice. But I have seen another condition which appears also to be due to the specific poison. The meatus is ulcerated at its outer part, the ulcer having irregular edges and a foul surface, and a copious discharge flows from the passage. When it is cleansed, the speculum shows its surface reddened, and excoriated in parts; the membrana tympani is vascular. I suspect the disease results sometimes from the direct application of the poison. The treatment

would be conducted on ordinary principles. In some cases an enormous swelling of the auricle attended with ulceration occurs.

Polypi frequently have their seat in the meatus, but since they more often accompany disease of the tympanum, they will be treated of hereafter.

Sebaceous or molluscous tumors are enlarged sebaceous follicles containing scales of epidermis, which form occasionally in the meatus. If their progress be unchecked, they are apt to destroy life by causing absorption of the bone and exciting disease in the brain.[1] They may exist and even prove fatal in early life, though they are most frequent in the old. They are attended in their later stages with discharge and pain. The treatment would consist in laying open the swelling, evacuating the accumulated laminæ of epidermis by the syringe, and then withdrawing by means of a forceps the thick membrane lining the tumor. But when they are chiefly situated within the tympanum, the diagnosis is difficult.

Exostoses sometimes form in the walls of the meatus; these may grow from either of its surfaces, and cases are not unfrequently seen in which two or more of such formations approach each other towards the mesian line. The hearing is by no means always impaired in proportion to the closure of the canal; but when the occlusion is complete, which I have twice seen, the deafness is considerable. Cerumen or epidermis may accumulate behind these growths, and will then require great patience, and a persevering use of fluids adapted to soften the mass, in order to effect its removal. This form of exostosis may occur in comparatively early life. Treatment is not so inefficacious as might have been feared. I have seen a severe case, in which the application of tincture of iodine seemed to induce a diminution of the tumors, and improvement of the hearing. Mr. Wilde speaks confidently of the power of local depletion, counter-irritation, and mercurials to arrest their progress in the early stage, when there probably exists a chronic state of periostitis.

[1] Mr. Toynbee first described this affection (see Med.-Chir. Trans., vol. xliv., p. 51, and Diseases of the Ear, 2d edit., supplement). Dr. Von Troeltsch believes the tumors are mere accumulations of secretion and not distinct growths, but I have met with them as small firm white bodies surrounded by a distinct membrane, in cases in which there was no evidence of any large amount of secretion. See Path. Trans., vol. xvi., p. 233.

[*Exostoses removed by the dental lathe.*—One of the newest and perhaps most successful ways of removing exostoses from the auditory canal is by means of small drills propelled by the dental lathe. Dr. Mathewson, of Brooklyn, N. Y., published the first accounts of its successful employment for the operation, in a paper read before the International Otological Congress held in 1876, in the city of New York.

"The machine employed was that known as Elliott's suspension dental engine, in which the power is supplied by a treadle worked with the foot, while the hand-piece, to which the burrs or drills are attached, held like a pen, can be raised or lowered, and turned in any direction desired." The patient is to be etherized, the meatus illuminated by the forehead mirror, on the operator, and then the skin should be scraped or scaled off the bony growth by another dental instrument known as the scaler. The bony growth may then be perforated at several points near its centre, with the smallest drills, about 1 to 1.50 mm. in diameter. The larger drills, 2.50 to 3 mm. in diameter, are next used to enlarge the perforations and run them together, "and by lateral pressure to ream out the meatus."]

II. AFFECTIONS OF THE MIDDLE EAR.

Affections of the membrana tympani.—The membrana tympani is a thin colorless diaphragm, stretched obliquely across the inner extremity of the meatus. In its healthy state it is almost transparent; it reflects light strongly, and owing to its peculiar curvature, presents a bright spot of triangular shape at its lower and anterior portion. This spot becomes obscured or altered in disease. Although the membrane is freely permeated by bloodvessels, which become turgid in congestion or inflammation, and may give it a deep red color, none, or only a few small ones, are visible in its normal condition. Its external surface is concave, with the exception of a narrow ring around its border. For practical purposes, the membrana tympani may be considered as consisting of three laminæ—dermoid, fibrous, and mucous; each of which may present distinct morbid conditions. The only guide to these is of course examination by the speculum. Inflation of the tympanum through the Eustachian tube, may also be had recourse to; certain effects of the pressure of air on the internal surface of the membrane, indicating tension, relaxation, rigidity, or ulceration of its layers.

In addition to the diseases which di-

rectly affect its own structure, the membrana tympani is often secondarily implicated in morbid conditions of more internal parts, and its appearance may give most important aid in their diagnosis. Thus in obstruction of the Eustachian tube the membrane is drawn inwards, its natural concavity being increased, and the polish of its surface diminished. Mucous or other accumulations within the tympanum may, on the other hand, cause it to bulge outwards; and the presence of an opaque fluid in that cavity may often be clearly recognized, through its transparent structure.

Injuries of the membrana tympani.—This membrane is liable to be ruptured from various causes, as the introduction of pointed instruments, a fall, or very loud sounds, such as the explosion of artillery, especially if occurring unexpectedly, so that the membrane has not been prepared for their reception by its adjusting muscles. A box on the ear, of which no warning has been given, will often produce the same effect, apparently by causing a compression of the air in the meatus, without the membrana tympani receiving the necessary state of tension. Sportsmen are liable to this accident from the report of their guns. Undue force of syringing, violent blowing of the nose, vomiting, paroxysms of whooping-cough, also have caused rupture of the membrana tympani; but in these cases there is little doubt that the membrane was previously weakened by disease. It may give way in death by strangulation. The symptoms of rupture of this membrane are pain, generally not severe, felt at the bottom of the meatus, soon followed by the appearance of a few drops of blood. The hearing is not necessarily impaired. If an examination is made shortly after the accident, a small clot of blood may be seen closing the wound, which is generally from a line to a line and a half in extent. In the majority of cases it heals speedily, and without any further symptoms. The clot falls off in the course of a few days, but a white cicatrix is visible for a long time. Occasionally, however, ulceration is set up, or a small portion of the membrane seems to slough, the aperture increasing in size for some days. In all cases I have seen, however, in which the rupture occurred in a healthy membrane, perfect repair has finally ensued, and without injury to the function of the organ. In the treatment, it is for the most part only necessary to guard the natural process of repair from interruption. It may be advisable, however, if there be discharge, cautiously to cleanse the meatus by the syringe. A leech or two may be applied to the edge of the meatus if irritation be present and the orifice seem extending, or the edges of the wound may be lightly touched with nitrate of silver. Indeed, under this latter plan, small orifices in the membrana tympani, that have existed for some time, will sometimes heal.

[When a perforation occurs in the membrana tympani from a blow over the auricle or from any traumatic cause, absolutely nothing should be dropped into the ear, because anything thus used would now enter the drum cavity and there excite inflammation. In cases of such injury the meatus should be stopped with cotton, and the entrance of air into the drum-cavity thus prevented.]

Inflammation of the membrana tympani.—Frequently the epidermis covering the external surface of this membrane is thickened and opaque, no other morbid condition being present. This is of no importance pathologically, but it is a frequent cause of what is described merely as "opacity of the membrana tympani," which in itself is of course not a cause of deafness. Congestion of the membrane may arise from exposure to cold; it is attended with a feeling of slight uneasiness inside the ear, and sometimes with buzzing noises; and on examination, enlarged red vessels may be seen on the surface. Avoidance of exposure, stimulating liniments, and warm oil dropped into the meatus, generally suffice for relief.

[All kinds of oils and fats, put into the ear, will generally prove in the end a source of irritation and disease, because of their liability to become rancid. When this decomposition of the fat sets in an inviting soil is provided for the fungus-aspergillus, and its growth soon excites an external otitis.]

The *dermoid* lamina is subject to acute and chronic inflammation.

Acute inflammation is not common as an isolated affection, but it seems to occur sometimes from the application of cold or of irritating substances in debilitated constitutions. The symptoms are pain, not very severe, generally attended with tinnitus and some diminution of hearing. The surface of the membrana tympani becomes of a red color, large and distended vessels being visible; it appears swollen also, and there is sometimes a secretion from it of viscid mucus. I have seen small abscesses form in this layer of the membrane and heal without permanent injury to the hearing. For the local treatment, one or two leeches may be applied to the orifice of the meatus; gentle syringing with warm water should be employed; and in the later stages mild astringents or a weak solution of the nitrate of silver may be had recourse to.

Chronic inflammation of the dermoid lamina may remain as an effect of the acute form; may arise from cold or other causes in weak or neglected children; may supervene in the course of, or after, the exanthemata; or may coexist with affections of the skin in other parts of the body; or with inflammation of the meatus. It occurs chiefly in the class of patients termed "strumous," and is said to have been observed to alternate with strumous ophthalmia. It is attended sometimes with a rather copious mucous discharge, at others with an excessive secretion of epidermis, which may accumulate in thick scales upon the surface of the membrana tympani, and give rise to deafness and great irritation. These scales may be removed by syringing, or, if difficult to dislodge, may be softened by the use of warm oil or water. The membrana tympani in some of these cases becomes greatly hypertrophied, and granulations of a bright-red color, and easily bleeding, may form upon its surface. This affection is generally painless; but in the severer forms the hearing is always impaired. In the treatment, cleanliness should be maintained by the syringe, and the greatest attention paid to the state of the health, which will almost invariably be found more or less deranged. In children, quinine, steel, and cod-liver oil are almost always useful. Sponging, friction of the skin, and other points of hygiene, require attention; and with these, local measures may be combined. Vesication may be kept up, gently, behind the ear, and astringent lotions dropped into the meatus; or the membrane may be washed over with a solution of ten or twenty grains of the nitrate of silver to the ounce of water. But before having recourse to any topical applications, it is desirable to give cleanliness, combined with good general treatment, a fair trial. A considerable improvement seldom fails to ensue.

That inflammations of this layer of the membrana tympani are sometimes *specific* in their character, can hardly be doubted; but no distinctive marks of the presence of the syphilitic, or scrofulous, or gouty taint, have yet been pointed out in the diseased structures. The diagnosis must be determined by the history and the general condition of the patient. I believe also, that in all such cases the chief seat of the disease is in the deeper structures of the ear.

It often happens that after the removal of hard and adherent masses of epidermis from the meatus the membrane is seen to present a red and tumefied surface, generally at the upper part, from which no doubt the diseased epidermis is thrown off. The affection is of considerable importance, because though it readily subsides if the meatus is thoroughly cleared, and a solution of nitrate of silver applied, it may lead if neglected to the most serious consequences. An inflammatory swelling of the meatus may at any moment supervene, and extension of irritation inwards then become very difficult to prevent. I believe this condition may result from injudicious cleaning of the ear.

The *fibrous* laminæ of the membrane appear to be subject to affections connected with a rheumatic or gouty diathesis; but in an acute form these are rare, and probably are seldom dissociated from general affections of the tympanum.

In *chronic* inflammation, the fibrous laminæ become thickened and hypertrophied, and the membrane presents a leaden appearance, often with congested vessels ramifying over its surface. The hearing is greatly impaired; which is less due, probably, to the condition of the membrana tympani, than to that of the lining of the tympanic cavity. The membrane may appear flattened, or if it retain its form and curvature, it is dense and rigid; and if the patient inflates the tympanum, while the surgeon keeps his eye fixed on the membrane by means of the speculum, the natural yielding to the stream of air is not perceived. Pain is seldom complained of, but there is frequently a great amount of tinnitus. The treatment of both these affections is the same as for inflammation of the cavity of the tympanum. Mr. Toynbee recommends also the application to the surface of the membrane of a solution of the nitrate of silver (ten or twenty grains to the ounce), but the advantage of any such applications needs further proof. In the entirely chronic stage ether or sp. camph., ʒj, with liq. opii ʒss, in glycerine ʒj, may give relief to the tinnitus.

There is an opposite condition to which the membrana tympani is liable, and in which its fibrous layers seem to be chiefly concerned—that of *relaxation*. Patients come before us in whom the membrane has lost its natural regular form, and appears almost as if crumpled, sometimes falling in towards the promontory. In some of these cases the polish and translucency of the membrane are scarcely at all diminished; in others it is opaque and dull, in others red and swollen. This "relaxation" sometimes coexists with inflammation, at others it seems to be connected with an "atrophy" of the fibrous laminæ, which cannot always be traced to previous inflammatory action; the scars resulting from previous loss of substance also generally appear as thinned and depressed spots. In some of these cases considerable deafness is present, which is relieved when the tympanum is

inflated and the relaxed portions of the membrane put upon the stretch, but soon returns. For these cases—*if the tympanum appears otherwise healthy*—various astringent applications may be tried, and also the plan recommended by Politzer, of retaining the membrane in its place, after inflation, by closing the meatus air-tight by means of a plug of cotton-wool rolled in wax, and worn for several consecutive hours. In a large proportion of these cases also the artificial membrane, or a plug of cotton-wool moistened in glycerine containing sulphate of zinc (gr. x–xx ad. ℥j), answers well—no doubt by maintaining the ossicula in better positions.

But in the vast majority of these cases the chief seat of the disease is more internal; often the Eustachian tube is narrowed though not necessarily occluded, or the results of old catarrh within the tympanum remain in the form of collections of viscid mucus, which demand evacuation by incision of the membrane. This is still more apt to be the case in the condition termed by Sir William Wilde "collapse" of the membrane, in which its natural structure and position are altogether lost, and it lies more or less unevenly in contact with the whole of the internal wall of the tympanum, the stapes and incus forming more or less distinct projections. In some of these cases a persevering treatment of the Eustachian tube, by bougies, etc., and the thorough evacuation of all morbid contents from the tympanum, will lead to a truly marvellous restoration of hearing, but the patient should be warned of the tediousness and probable painfulness of the treatment and, in bad cases, of the uncertainty of the result.

[Wart-like bodies on the membrana tympani have been described by Urbantschitsch, of Vienna, and endothelial cholesteatoma, and cholesteatoma of this membrane have been observed and fully described by the late Dr. Wendt, of Leipsic.]

Ulceration of the fibrous laminæ may occur, though not frequently, as a result of their continued inflammation. The dermoid layer of course partakes in the affection, and it is attended with a discharge from the meatus. It may either lead to perforation, or result merely in a thinning of the membrane, the mucous layer retaining its continuity. In the latter case the ulcerated surface appears depressed below the general plane of the membrane; it has an irregularly circular shape, and sometimes occupies a considerable extent. When the tympanum is inflated, the mucous membrane, lacking support, bulges at this spot, and may be distinctly seen to form a projecting sac. This condition seems not to be always accompanied with other disease, and is susceptible of benefit, especially if the ulceration be extending, by a weak solution of nitrate of silver cautiously applied to the surface; general treatment being at the same time adopted.

Calcareous deposits are frequently seen in the membrana tympani; they present chiefly two forms: either that of a small crescentic layer, evidently taking the course of the circular fibres; or that of an irregularly radiating mass, which has its seat amid the radiate fibres. These deposits are generally met with in cases of long-standing inflammatory disease, and then deafness is present; but they do not seem to be themselves any considerable impediments to hearing, since they are also seen in persons whose hearing power is scarcely diminished, and in whom the membrane itself appears to be in other respects in its normal state. Sometimes the degeneration affects the entire extent of the membrane, which is thus converted into a bony mass. But in these cases there is usually also extensive disease of the tympanum. These deposits consist chiefly of phosphate of lime. They are most frequent when the membrane is perforated, and a chronic inflammation of the tympanum has existed for a long time; but they are by no means confined to the later periods of life. In all these cases, any inflammation that exists may be combated by appropriate means.

In some of these cases *incision* of the membrane will give great relief, alike to the deafness and to the tinnitus if any be present, or if a simple incision be not sufficient, the *excision* of the diseased portion of the membrane—a proceeding first carried out by Dr. J. Gruber of Vienna—will often be very effectual. This last operation may be carried out by a simple knife, like a small and very thin-handled cataract knife, and a delicate pair of curved forceps. I have known not only the hearing greatly improved, but very distressing sensations of oppression in the head immediately relieved by it. The only drawback is that owing to the very strong tendency of the membrane to heal, the relief is generally but temporary. To obviate this Dr. Adam Politzer of Vienna has suggested the introduction into the incision of a small vulcanite ring, grooved so as to remain *in situ*, and with a silken thread attached to insure its not falling into the tympanum. That this procedure is efficacious to a certain extent I have proved; but my experience does not enable me to say whether a *permanent* benefit can be secured. With due precautions I have not found it give rise to irritation.

The class of cases in which *incision of*

the membrane is useful is difficult to define, and I confess that my own practice in this respect is as yet largely guided by theory. Where abnormal "tension" appears to exist, it is reasonable to have recourse to it if other means fail, especially since it is very slightly painful and may be said to be wholly free from danger, either of exciting irritation or injuring the hearing. In some cases it appears to act favorably by diminishing such tension, as indicated by a wide gaping of the wound. In others there is no such appearance, the edges of the incision remaining simply in contact; and in some of the cases in which the greatest relief has been given the membrane has appeared to be flabby and soft, even in an extreme degree, cutting like a layer of soaked leather. But the very temporary nature of the benefit procured when incision is had recourse to except as a step to further procedure, greatly reduces its value.

Fabrizzi's instrument for excising a circular portion of the membrane does not appear to have any special advantage over a simple double-edged knife, by which a portion can be excised if desired, or a crucial incision made and the edges turned back. It has been proposed to obtain a permanent opening by inducing adhesion of the edges of a triangular flap of the membrane to the internal wall of the tympanum or the wall of the meatus.

Dr. Wreden, of St. Petersburg, has introduced an instrument, combining a small revolving blade and a forceps, by which the whole or the greater part of the handle of the malleus can be removed, together with the adjacent membrane. There is no reason to doubt that great relief is thus afforded in some cases, but whether it is permanent or not, does not yet appear. The method that seems at present to me most deserving of further trial is the "ring" suggested by Dr. Politzer.

Perforation: the artificial membrana tympani.—The membrana tympani may become perforated in two ways: either by disease affecting the membrane itself, and usually progressing from without inwards, by ulceration of its laminæ, or much more frequently as the result of inflammation within the tympanum, causing accumulation of mucus or other morbid secretion within that cavity, which at length finds its way through the membrane into the meatus.

The diagnosis of perforation is generally easy. After the meatus has been cleaned out with warm water, the orifice may for the most part be very distinctly seen by the aid of the speculum. Or a peculiar pulsation (first described in this relation by Mr. Wilde) visible in the situation of the aperture, and probably due to the presence of a film or bubble of water, is very characteristic. If the Eustachian tube is not obstructed, the patient can blow air through the meatus with a prolonged whistling sound, which is perfectly diagnostic of the affection. If he cannot, it can generally be caused to pass by Politzer's method of inflation (see p. 194) or the Eustachian catheter. The aperture may be of any size, from less than that of a pin's head to almost the entire extent of the membrane. When the destruction of the membrane is considerable, the remaining portion usually presents a distinct lunated edge; and if the greater part is absent, the handle of the malleus, with a narrow strip of membrane on each side, is generally to be seen, either occupying its natural position, or fallen inwards. Sometimes this portion of bone remains with no membrane attached; sometimes the head of the malleus alone is left, and forms a prominent and characteristic object near the roof of the meatus. The border of the remaining portion of the membrane may be adherent to the promontory, forming a more or less completely closed cavity; and if by this means discharge is prevented from escaping, serious consequences may ensue.

Perforation of the membrana tympani produces, for the most part, a certain amount of deafness, though when the aperture is small and the ear otherwise healthy this is so slight as to be scarcely appreciable. In recent cases the closure of the orifice, if small, is always to be sought; the occasional application of a solution of nitrate of silver (℈j–℥j ad ℥j) to the edges of the wound, and the subjugation of inflammatory action by appropriate means, will generally secure this result. In fact, the extent to which loss of the membrane may be restored, in the course of time, is very remarkable. I have now under my observation a child of twelve, in whom four years ago nothing of the membrane existed beyond a scarcely visible margin; the whole of the anterior and lower portions are now replaced by a distinct transparent layer, which the eye could not distinguish from the natural membrane, and which is thin inferiorly, and somewhat whiter and thicker anteriorly. There is every reason to believe that the restorative process in this case is not yet complete. It was treated by me by means of talc, as described hereafter. But almost always when the membrana tympani is perforated there exists a state of chronic irritation of the lining membrane of the tympanum, attended with either a constant or an intermittent discharge. On examination a fetid mass of inspissated discharge will generally be found in the meatus, itself sufficient to set up inflammation; and on syringing this away the mucous membrane of the

tympanum will be seen red, swollen, and velvety; often so thickened as to project almost to a level with the orifice in the membrane. In the treatment the chief point is to secure the perfect removal of the morbid secretion, which is apt to be extremely viscid, from all the recesses of the tympanum and Eustachian tube. In my opinion the difficulty of insuring this is the sole cause of the proverbial tediousness and unsatisfactoriness of these cases. And, fortunately, the very existence of the perforation puts it in our power completely to evacuate the tympanum, by passing fluids from the meatus inwards through the Eustachian tube. Above, and almost even in the place of, all other things, the treatment of chronic perforations of the membrana tympani should consist in first washing out the cavity by means of alkaline solutions passed from the meatus through the Eustachian tube into the fauces. This is not painful unless irritation exists (which should be, as far as possible, subdued), or the tube is closed, which then should be first rendered patent. It is very simply done, and the only ill effect I have known ensue is a temporary giddiness, lasting a minute or two. This giddiness is, of course, much greater when the water used is too cool or too warm, but it will sometimes occur without any error of temperature. It affords no reason for modifying the treatment. An ordinary syringe suffices, a piece of India-rubber being placed upon the nozzle, so as nearly to close the meatus. When the surgeon has proof that the membrane is really perforated, and that the Eustachian tube is pervious, very considerable force, if it is necessary, may be safely used; and the stream will often bring away enormous and almost incredible masses of more or less altered and inspissated secretion, with manifest improvement. The proceeding should be repeated as often as seems necessary, even for many weeks in some cases. I have known semi-solid masses of old offensive secretion to come away from a tympanum which had been thus treated, even after a stream of fluid had been several times passed through the ear without removing anything more than a few flakes of recent mucus; and my conviction is that in some, both of these cases and of those in which I am in the habit of incising the membrane with the view of thus washing out the tympanum, the mastoid cells and other recesses of the cavity gradually empty themselves beneath the influence of the stream; and that masses of half-dried mucus which have been accumulating for years may be thus dissolved and washed away. I believe that experience of the method could not fail at once to convince and to astonish every one who tried it. I use first alkalies—soda, or carbonate and chlorate of potash—in nearly saturated solutions, and afterwards employ for the most part alum or sulphate of zinc (gr. iv–x ad ʒj).

At the same time, if granulations are present, I apply caustics; generally either a strong solution of nitrate of silver, or, if a powerful action is required, chloro-acetic acid; but chloride of zinc, also, is very effective—either may be applied by a camel's-hair brush.

Dr. Schwartze, of Halle, has strongly recommended, for the treatment of perforations when no granulations are present, solutions of nitrate of silver (from two to forty grains to the ounce). These he pours into the ear, and then, by means of a glass tube, made to fit the meatus by India-rubber, blows them through the Eustachian tube so as to reach the fauces. Immediately afterwards he syringes out the ear with a solution of common salt, causing it to pass as far inwards as the caustic has done. The insoluble chloride of silver is formed, and comes away in large flakes. Excellent results, no doubt, are thus attained, but it is necessary to use caution, as the pain caused by too strong a solution is very severe. I should always postpone its use until after the ear had been repeatedly syringed *through*, as described above, with an alkali, and some mild astringent. Dr. Schwartze recommends it to be repeated daily for a few times, the discharge soon ceasing under its use in his hands. Another method of bringing about a permanent cessation of discharge when granulations are removed, or even before, is to employ talc (French chalk) in powder. All discharge being removed by syringing—for which purpose the patient should blow through the ear while the syringe is used—the surface should be thoroughly dried, as far as possible (lint rolled up, or the fringe of a towel, answer well).[1] A little of the powdered talc should then be taken up in a small glass tube and blown into the meatus by a sharp puff. An elastic bag is preferable to the mouth. This should be repeated, if necessary, until the bottom of the meatus is well covered. The process should be repeated daily, and it is seldom that many applications are necessary; but the ear should be, each time, well cleansed and dried. I know no more effective plan than this, but it is somewhat tedious, and requires daily attendance, and is, therefore, naturally reserved for the more obstinate cases.

Of lotions I have found the perchloride of mercury the best as a general rule: a third of a grain to the ounce is almost

[1 Aurists now use absorbent cotton twisted on the dental cotton-holder.]

always well borne; if stronger it is apt to be irritating. With it, as with every lotion, I combine opium or morphia, giving the preference to the tincture, from two to thirty drops. Of proper astringent lotions the sulphate of zinc (gr. ij–x ad ℥j) stands first; next to it the liq. ferri perchlor. (♏ x ad ℥j); and then tannin (gr. x ad ℥j). Whatever lotion is used, the patient should fill the ear, force air through the Eustachian tube freely, and let it run out, repeating this two or three times morning and evening. Syringing for himself is seldom useful, unless the patient can see the surgeon only at long intervals. The liquor plumbi is seldom advisable as a lotion in perforations, though it is often useful in granular conditions without rupture, and is very useful applied undiluted to granulations, or to the roots of polypi growing from the edges of an orifice or the tympanic wall.

It sometimes happens that an orifice in the membrane is of too small a size to permit the complete escape of the discharge. In this case the irritation continues in spite of treatment, and the membrane often assumes a red, and, in parts, granular aspect, and appears irregularly swollen. When air is forced into the tympanum it will sometimes escape through a minute orifice, bringing with it bubbles of air and mucus; at others, though it enters the drum, it does not pass through the membrane until a little viscid mass has been first protruded. I have in some cases clearly seen two such minute orifices. The treatment I employ, after a due trial of other means, is to enlarge the outlet by incision.

The most tedious perforations that I have met with are those which are situated at the anterior and lower part of the membrane, very near to the wall of the meatus. I believe the reason is that the perfect emptying of the tympanum is more difficult owing to the orifice being nearly in a line with the Eustachian tube; so that the posterior part of the tympanum remains very much a closed cavity.

The artificial membrana tympani.—To however great an extent the membrana tympani may be destroyed, the hearing may suffer comparatively little, and with the treatment above described, it often happens that not only the discharge ceases and the exposed surface assumes a healthy aspect, but the hearing recovers sufficiently for all the patient's needs. Should this not be the case it is probable that there exists some relaxation of the connections of the ossicula. In such conditions astringent solutions, as sulphate of zinc, often produce great temporary improvement, but the remedy is some form of artificial membrane—either the moistened cotton-wool of Mr. Yearsley, or the India-rubber disc or globe proposed by Mr. Toynbee. Each form has its special advantages, and a case that seems to demand it should not be abandoned till all have been tried. For the cotton-wool I prefer glycerine to water, as it then will retain sufficient moisture not to need changing for four or five days; and in most cases I add to the ounce of glycerine from five to twenty grains of sulphate of zinc. Being rolled up into a small spindle-shaped plug, about half an inch long, it may be introduced either by a pair of forceps, or threaded through a narrow silver tube.[1] I think it is best to direct whatever form of artificial membrane is used towards the upper and posterior part of the tympanum, so as to touch, if it be present, the head of the stapes. A little pain is sometimes complained of, but if the attempt succeeds well the patient is immediately conscious of hearing better, and the cotton or disc should then be left *in situ*, and the tube or forceps carefully withdrawn. After a little instruction from the surgeon the patient soon learns to apply it himself, and if care is taken to prevent accumulation of discharge or epidermis, the effect continues indefinitely, and often becomes, even in cases of otherwise extreme deafness, so permanent as to render possible the discontinuance of the membrane. If the India-rubber disc is used, one made with a thread attached, and introduced by means of a tube, is preferable to one fixed upon a wire. Mr. Toynbee says:—

"After accurately noting the size of the inner extremity of the meatus to which the natural membrane was attached, the operator should proceed to cut the artificial membrane as nearly of the size and shape of the natural one as possible, taking care at the same time to keep the margin quite smooth and regular. The patient should then be placed with the head inclined to the opposite shoulder, while a strong light is thrown into the meatus, which, if liable to discharge, should have been previously syringed. The operator will next take the artificial membrane, and having moistened it with warm water, pass it, by means of the silver wire, gently inwards, until it has reached what he considers the natural position. This he will ascertain by the occurrence of a faint bubbling sound caused by the escape of the slightly compressed air beyond it; he will also feel a slight obstruction offered to its further passage by the remnant of the natural membrane. Should any attempt be made to pass the artificial membrane beyond this point, the patient will complain of pain, which up till then had not been felt. The most certain

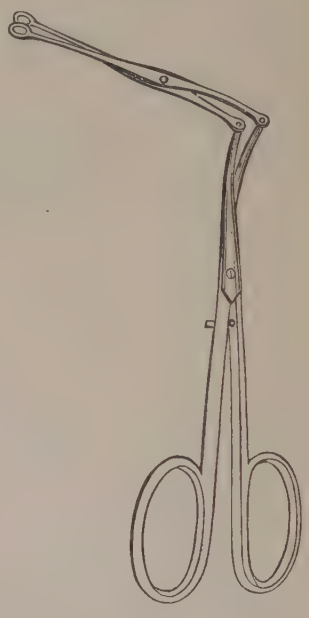
[1] Prepared cotton, etc., as also all the other forms of artificial membrane, are sold by Messrs. Weiss, of the Strand.

test, however, of the proper placing of the artificial membrane is the sensation of the patient, who discovers by the sound of his own voice, of that of the surgeon, or by the movement of his tongue and lips, that his hearing has been suddenly improved."

It is advisable, when there remains only a very narrow ring of the natural membrane, to cut the artificial one a little larger, so that its edges may turn slightly backwards when it is introduced. I have, however, sometimes found that a portion of membrane, cut to the shape of the aperture, but a little larger in size, and applied directly to the ruptured spot, has answered better than when the whole surface has been covered. At first the artificial membrane should be worn only for an hour or two or even a shorter time, daily, and should be discontinued for a time if any irritation arise. It should be removed at night.

Polypi.—These growths may, for practical purposes, be divided into cellular and fibroid, according to the density of their structure, and the corresponding difficulty of eradicating them; some of the more dense of the latter also bleeding very considerably when removed. But minute examination reveals considerable complexity of structure in some of these formations, and there is an accumulating body of evidence that their structure varies definitely according to the surface from which they spring, and that those which arise from the meatus, or from the walls of the tympanum, possess a corresponding glandular structure which is wanting in those which spring from the outer surface of the membrana tympani. Their most frequent seat, in my experience, is the inner wall of the tympanum, the membrane being ruptured; but it is important to remember that they may form within the tympanum without the existence of any perforation. In this case they may either cause the membrane to give way, and literally grow through it, or at least appear to do so, or they may remain within the cavity, giving rise to great irritation, and require treatment by incision. In one such case (see Clinical Society's Transactions, vol. ii.), a polypus nearly as large as a pea was evacuated, with entire relief, having apparently become detached, and acting as a foreign body. Twice, in post-mortem examinations, I have found small polypi growing from the *inner* surface of the membrana tympani. Next to the exposed tympanic wall the most frequent seat of polypi is the inner part of the meatus, and then the external surface of the membrane. Whatever their seat and nature they require essentially the same treatment, viz., the soothing of any irritation; the removal, as far as practicable, of all accumulated discharge; the eradication of the growth, and restoration to a perfectly healthy state, of the surface from which it sprang. For the first purpose, if any means are necessary, leeches, a few small blisters, and lotions of diluted liq. plumbi are the best; the second may be effected by syringing with alkaline solutions, forcing them through the tympanum if a perforation exists, and by the nose douche, or the patient drawing or syringing through the nostrils a solution of soda (gr. x ad ℥j). [Drawing fluids through the nostrils, or passing them through by means of strong syringing or the nasal douche from too high an elevation, is now considered by aurists to be attended with great risk of injury to the ears. The surface of the fluid in the nasal douche should never be higher than the forehead of the patient: should it be elevated above this, the fluid easily passes into the tympanic cavity through the Eustachian tube.] For the removal of the polypus, if it be of any size, I prefer Sir W. Wilde's snare, armed not with wire, but with the gimp used by anglers. This is much less fragile, and less painful. The polypus may generally be thus cut through close to its root. When too small to be grasped by the snare, Mr. Toynbee's "lever ring forceps," consisting of two small rings closed by a movable canula, or that here depicted, are both very efficient.

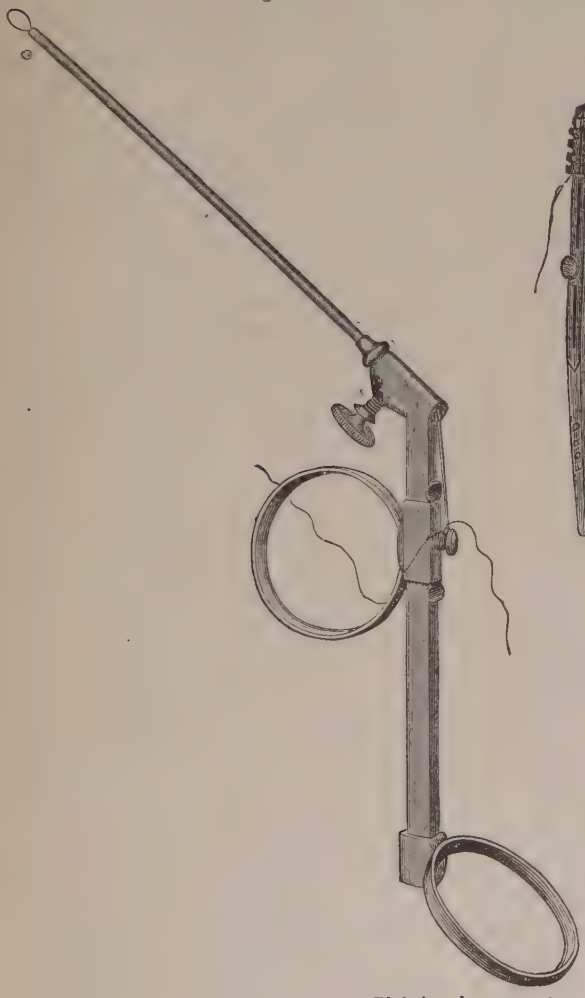
Fig. 287.



Forceps for extracting small polypi.

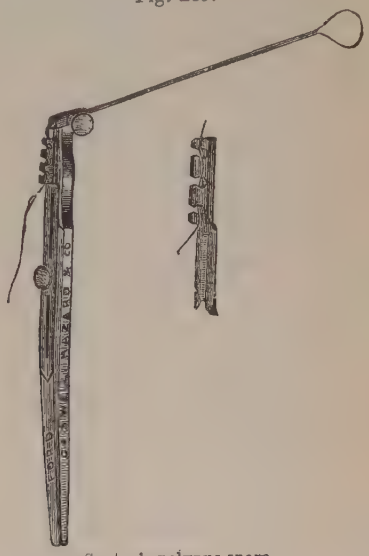
[*Removal of polypi.*—When polypi are attached to the deeper parts of the auditory canal or to the membrana tympani, or if they protrude through perforations in the latter, from the tympanic cavity, they cannot be removed unless a slender form of Wilde's snare is used. The original Wilde's snare, if not too bulky, will be found perfectly efficient for the removal of polypi from the outer part of the auditory canal. But this instrument in its original and bulky form cannot be used without great pain to remove a polypus from the neighborhood of the membrana tympani. The diameter of the canal at this point is about 10 mm. If this space is crowded by even a small polypus, it becomes very easy to understand how necessary a slender instrument is, if success is to be obtained. To replace the somewhat clumsy Wilde's snare, Dr. C. I. Blake, of Boston, suggested some years

Fig. 288.



Blake's polypus snare.

Fig. 289.



Sexton's polypus snare.

ago,[1] to run the wire forming the loop through a narrow canula, or barrel, instead of on each side of a thick metallic bar. The canula, which may be of silver or of steel, should not be more than 1–1.50 mm. in diameter, for the narrower the barrel, the more light is allowed to enter alongside of it, from the reflector, during an operation. The instrument, which the editor has found of great value, is given in its natural size in Fig. 288.

Dr. Samuel Sexton,[1] of New York, has further improved this form of polypus

[1 Leiter's Catalogue, Vienna, 1869.]

[1 See further, American Journal of Otology, vol. ii., p. 298.]

snare by giving the wire "three abrupt turns through notches cut rather deeply in the slide for its reception." See Fig. 289.

These instruments can be introduced into the auditory canal, under good illumination from a forehead-mirror—but not otherwise—and the polypus easily caught in the loop. By steady constriction the polypus is detached from its pedicle, and then removed with the instrument. These improved and small instruments are easily efficient, when the ordinary Wilde's snare could not be even introduced, on account of its large size, as far as the fundus of the auditory canal. The pain felt in an operation for the removal of an aural polypus is caused by the touching and abrasion of the walls of the canal, the growth having no sensibility. The smaller the instrument, therefore, the less the likelihood of touching the wall of the canal.]

After a polypus of long standing has been removed, it frequently happens that large masses of old, half dried offensive discharge are exposed, and may be removed by the syringe, or the surface is found covered with dense layers of epidermis requiring a prolonged use of alkaline lotions to soften them. When this is the case the removal of the growth often gives relief to very distressing symptoms.

But after this has been done the real treatment of the case commences: for, as a rule, no sooner is a polypus removed than it begins at once to reproduce itself, and the only means that can be relied upon to prevent this are to apply caustics, and afterwards other astringent or drying substances, *keeping the tympanum sedulously free from collections of discharge*, until a perfectly healthy state of the surface is induced. Without carrying this process thoroughly to a conclusion, to remove a polypus, unless for temporary relief, is to inflict useless pain. Liq. plumbi, applied by a camel's-hair brush daily for a few days before the caustic, greatly diminishes the pain. Chloroacetic acid, potassa fusa, carefully guarded, chromic acid, or chloride of zinc, are good caustics. Nitrate of silver is excellent in the later stages. The caustic is best applied daily until a decided effect is produced, this being by far the least painful and tedious mode of using it. [All of these powerful caustics are to be applied in small quantities directly to the diseased spot, *i. e.*, either to the granulations or the cut surface of the pedicle of a polypus, by means of cotton twisted on the roughened end of the cotton holder. They must never be dropped into the ear with the hope that they may find their way to the diseased spot.] At the same time, a lotion of perchloride of mercury (gr. ½ ad ℥j) with tinct. opii ♏ v–x should be used twice a day; the Eustachian tube, if closed, should be made pervious; and if the membrane be perforated, a syringing from the meatus through the nostril practised frequently, as above described, unless it be contra-indicated. When the root of the polypus shows manifest signs of disappearing we can often substitute for the caustic the undiluted liq. plumbi, or the powdered talc. By these means polypi of the largest size and most obstinate character may, so far as my recent experience extends, always be entirely eradicated, and the tendency to their reproduction destroyed; or, if there be any exception, it is in some rare cases of the densest and most vascular form of fibrous polypus, in which the use of caustic results in a drying up rather than a total removal of the mass. The time occupied in the entire procedure varies from three weeks to three or four months. It is desirable not to commence it except with a thorough understanding on the patient's part of its tediousness, and unless completed, its uselessness; but I have not known any one who persevered regret the trouble. The surgeon should remember that these growths are very often, probably most often, multiple, and this from the very commencement. I have syringed from a child's ear four distinct minute polypi, each one evidently a separate growth.

Instead of removal, injection into the substance of the polypus of a few drops of liq. ferri perchloridi has been practised with success, but I have not sufficient experience to speak positively of its results. Before removal the soft and sensitive texture may be deadened by a few applications of liq. plumbi in which morphia has been dissolved; and I have sometimes caused sloughing of one of the softer kind, when removal was refused, by pressing into its substance a fragment of nitrate of silver. But the pain of treatment by caustics, of course, greatly exceeds that of the snare.

Granulations on the surface of the membrana tympani are not uncommon, either with or without perforation. Their treatment is essentially that of the root of a polypus, but their presence almost certainly indicates disease within the tympanum, the treatment of which is of the chief moment. Very frequently the membrane demands incision.

[*Granulations treated by alcohol.*—Prof. Adam Politzer, of Vienna, has claimed for absolute alcohol the power of quickly and painlessly destroying polypoid granulations and the pedicles of true polypi in the ear.[1] The usefulness of absolute al-

[1 Wiener Med. Wochenschrift, No. 31, 1880.]

cohol is based on its astringent and coagulating power. When used to destroy granulations in the ear, ten to fifteen drops may be instilled into the meatus and allowed to remain in the ear ten minutes. This application may produce at first a sensation of heat or burning, but after a few applications have been made, this sensitiveness passes off. Its use is entirely free from danger so long as the patient's head is not brought too near a fire or a lighted lamp, and may be employed very conveniently by the general practitioner. When absolute anhydrous alcohol cannot be obtained, strong spirits of wine may be employed. It must not be understood that this is the most efficient of the astringents and caustics in use among specialists, but its use does not demand special instruments or skill, and thus is available to the general practitioner.]

Affections of the Eustachian Tube.

The ordinary condition of the Eustachian tube, as shown by Mr. Toynbee, appears to be that of closure by the apposition of its walls. It is opened by the tensor palati during the act of swallowing, and probably at all times, when in a healthy state, permits the gradual escape from the tympanum of fluids as well as of air. That it is not permanently open is shown by the effect of inflating the tympanum with closed mouth and nostrils, the feeling of distension within the ear produced by which only gradually subsides unless the act of swallowing be performed, when it disappears at once. If this experiment be made by a healthy person while the surgeon keeps his eye fixed upon the membrana tympani, that membrane may be seen to yield slightly to the pressure of the air, assuming a less concave position, which is retained for a time, even while the natural respiration is carried on. If the act of swallowing be now performed, the membrane may be seen to fall back at once to its normal position. Similar effects are said to be experienced during a descent in a diving-bell. In addition to these facts, certain symptoms which attend *an open condition of the Eustachian tube*, first described by Dr. Jago, of Truro, give evidence in the same direction. This affection is attended with a buzzing noise, and an unnaturally vivid hearing of all sounds which have their origin in the patient's own mouth, throat, or stomach, to such an extent as greatly to interfere with the hearing of external sounds. There is at the same time a feeling of discomfort in the throat, which the patient endeavors to relieve by repeated acts of swallowing. The cause of this condition appears to be some state of the throat, but of what character is not clear; perhaps some irritation keeping the muscles attached to the Eustachian tube in a state of spasmodic action. The symptoms occur most frequently during catarrhal affections. For the most part they are intermittent, the restoration of the natural apposition of the walls of the tube removing them at once.[1]

Much more frequent and more serious is the opposite affection, *obstruction of the Eustachian tube*. This condition may be due to various causes; thickening of the mucous membrane of the fauces or tympanum, or relaxation of the fauces, appear to be the most frequent. Stricture of the osseous walls of the tubes occurs sometimes, though rarely; firm membranous adhesions are occasionally found completely closing it, and accumulations of mucus no doubt have a similar effect. It is questionable whether enlargement of the tonsils can cause obstruction of the tubes. In reference, therefore, to the question of the removal of these glands in cases of deafness dependent on the condition of the throat, there seems to be no reason for departing from the rule that if their removal is desirable on general grounds, that is, if they are interfering with respiration and injuring the health, they should be excised, and not otherwise; unless, perhaps, in cases in which other means have failed, when the chance of benefit to the hearing may be weighed against that of injury to the patient from their loss. The slight loss of blood attending their excision may perhaps have a beneficial influence.

The diagnosis of obstruction of the Eustachian tube may be made by inspection of the membrana tympani, and by the use of the otoscope. This instrument is a flexible tube, one end of which is to be

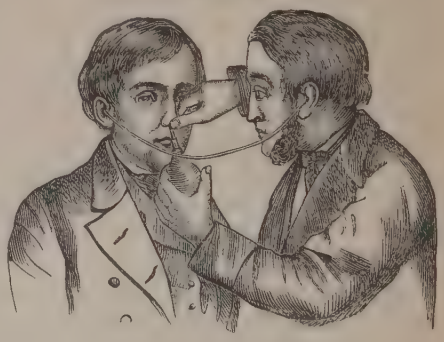
[1] It has been recently shown by Dr. Rüdinger, of Munich, that the Eustachian tube consists of two portions, the narrow and slit-like tube being seen, on section, to terminate above in a kind of a hook; *i. e.*, a small circular canal runs along the superior border of the flat one. It has been argued that this is always open, but the question seems not practically important, the interchange of air by means of it being at least very slow. That there is a muscle which closes as well as one which opens the Eustachian tube is indicated by many phenomena of disease; perhaps especially by the effects of local irritants which tightly close it. Sulphate of zinc, *e. g.*, syringed along it, makes it for a time quite impervious. Dr. Von Troeltsch (Archiv für Ohrenheilkunde, vol. i., p. 15) has argued from anatomy that the tensor palati alone opens the tube, the levator serving to close it.

inserted into the ear of the surgeon, and the other into that of the patient, while the latter, closing the mouth and nostrils, either makes a forcible expiration or performs the act of swallowing. If the Eustachian tube be pervious, the air will almost always be heard (after some practice) to pass into the ear during one or other of these operations. The sound that results when the organ is in its normal state is a peculiar *thud*, somewhat like the striking of a bullet against a target, heard at a great distance, or like the blowing suddenly into a small bag of silver-paper. When disease is present this sound may be variously modified; a creaking or whistling may be heard if the Eustachian tube be narrowed by thickening of its lining membrane; a "gurgling" indicates the presence of mucus or other fluid within the tube or tympanum. It is seldom the case that if the Eustachian tube be pervious no sound is audible, when the patient has learnt rightly to make the experiment; and if neither any sound can be heard nor any movement of the membrana tympani seen during the actions above described, and the other symptoms agree, obstruction of the tube may be confidently inferred. But the appearance of the membrana tympani also, in these cases, is very characteristic. Whether it be due to absorption of the air within the tympanum, when it is not freely renewed, or to any other cause, the membrana tympani always, when the Eustachian tube is permanently closed, becomes more concave than natural, as if drawn or pressed in towards the cavity of the tympanum. It becomes at the same time of a dull color, and frequently somewhat opaque, the bright spot on its surface being indistinct and diffused. This condition of the membrane may be distinguished from the results of inflammation by the more decided concavity, without irregularity, and the absence of congestion or thickening.

The history also is characteristic of the disease. The deafness has for the most part arisen gradually, without any considerable amount of pain, and after repeated attacks of cold or sore throat. Often the hearing will have been suddenly restored at various periods after a loud crack or report in the ear, and gradually lost again.

Obstruction of the Eustachian tube from thickening of the mucous membrane of the fauces.—This affection is more frequent before than after middle age (the deafness of advancing years being more connected with morbid conditions of the tympanum); and it is especially common in scrofulous or otherwise unhealthy children. The appearance of these latter patients very often at once betrays the nature of the malady; there is a fulness about the back part of the jaw, and, especially when the tonsils are also enlarged, they have a peculiar expression of countenance, arising from the mouth being kept slightly open to aid in respiration. They are also apt to snore when asleep. The deafness in these cases is considerable, the patient requiring to be spoken to in a distinct voice within a yard or two. A "stuffing" in the ears, and more or less tinnitus, are generally complained of. The mucous membrane of the fauces is generally red and tumid. The treatment indicated is to restore the health, to remove collections of mucus in the fauces, and to reduce the thickened membrane. But besides these means it is desirable, with very few if any exceptions, to take advantage of a proceeding beautiful for its simplicity and invaluable for its results, introduced by Dr. Adam Politzer, of Vienna, as a means of opening a closed Eustachian tube without having recourse to the catheter. Taking advantage of the natural opening of the tube during the act of swallowing, Dr. Politzer suggested that air should be forcibly blown into the upper part of the pharynx by the surgeon, while the patient swallows with closed mouth and nose. This is very easily effected, either by means of an India-rubber bag, or by a tube through which the surgeon may blow. First directing the patient to take a little water in the mouth, and to swallow it with closed mouth at a given signal, the surgeon next introduces into one of his nostrils the nozzle of the elastic bag

Fig. 290.



Politzer's method of opening the Eustachian tube.

(best ending in a piece of elastic tube), and at the same time that the patient swallows he forces the air powerfully into the nose. Unless the obstruction be very great the air is almost sure to pass freely up the tube, and if the surgeon uses an otoscope (a simple piece of elastic tubing eighteen inches long is the best) he will

hear it enter the tympanum. A loud clapping sound is sometimes heard, and is almost a certain indication of a restoration of the hearing; at other times the sounds are obscure or decidedly *moist*, indicating fluid within the tympanum, and the effect is slighter, or null. These cases belong to disease of the tympanum. If on the other hand the only or chief abnormal condition has been the closure of the tube, the effect is most striking, and to the patient often most startling. In confirmed cases it is desirable to repeat this proceeding more or less frequently, and it often suffices, combined with general treatment; and especially with the use of a solution of soda or common salt, drawn or syringed through the nostrils, as before described.[1] For bracing up the thickened membrane, I prefer to nitrate of silver, etc., dried alum, powdered and blown into the angle behind the tonsil through a curved glass tube. An adult can quite easily draw in the powder for himself, by *sucking* through the tube. The alkaline solution through the nostril, combined with the powdered alum thus applied, is a very efficient plan of treatment. Sometimes, but rarely, a leech or two applied beneath the ears, or, by means of a tube, to the nasal mucous membrane on the affected side, or in both these situations at once, are desirable at the commencement of the treatment. [Leeching will prove of no avail in any stage of ear disease, excepting the early one of otitis media acuta, and in the opinion of the editor a leech should never be applied to the nasal mucous membrane.] Stimulating and astringent gargles or inhalations may also be used if necessary. Frictions around the throat, either with salt and water or with stimulating liniments which may contain salts of iodine, will of course be recommended, together with ample exercise in the open air, and cold or tepid sponging. Tonics are often indicated, especially in children; the acid mixture of iron and sulphate of magnesia is the form that I prefer. The Eustachian tube may also be obstructed by thickening of the membrane lining its tympanic orifice, as a result of chronic inflammation within the tympanum.

Relaxation of the mucous membrane of the fauces will also produce closure of the Eustachian tubes. This condition is different from that of thickening, and occurs in a different class of patients. It is met with only in adults; chiefly in persons in weak health, and suffering under general relaxation of the system. Those who smoke to excess are especially liable to deafness from this cause. The lining membrane of the throat is pale and mottled, the uvula is elongated. The membrana tympani presents the characteristic dull and concave appearance. General bracing and tonic measures, with stimulating and astringent applications to the fauces and the orifices of the tubes, and the abandonment of any practices injurious to health, will effect a cure.

The Eustachian tube may also be obstructed by stricture of its bony walls. Two cases are reported by Mr. Toynbee. The same effect may be produced by effusions of fibrin uniting its surfaces by firmly organized tissue. In such cases as these the chief point would be to make an accurate diagnosis, and to avoid subjecting the patient to useless treatment. The exploration of the canal by an elastic sound would of course be necessary.

Among the rarer causes of obstruction of these tubes may be mentioned, on the authority of Sir W. Wilde, foreign bodies; "the most remarkable case on record is that in which an ear of barley was discovered after death projecting from its guttural orifice." The same author also mentions that he has seen deafness induced by a large fleshy nasal polypus, which passed down into the pharynx.

In cases in which the obstruction of the Eustachian tube will not yield to the means prescribed, recourse must be had to the *Eustachian catheter*, the use of which is happily, as a rule, free alike from pain and danger. The patient being placed in an easy posture, the surgeon, standing on his right side, should take the catheter lightly between his finger and thumb and pass it gently along the floor of the nostril until it reaches the pharynx. [After the catheter has been thus introduced through the nose, no other form of inflation should be practised, for fear of inducing emphysema of the mucous membrane in the fauces and about the larynx; for if, in the introduction of the catheter, a slight abrasion in the mucous membrane of the naso-pharynx should have occurred, emphysema might then ensue on any kind of inflation of these parts.] At this point either of two methods may be adopted for conveying it to the opening of the tube. It may be carried on, its point still turned downwards, until it reaches the posterior wall of the pharynx, and then it may be drawn forwards about half an inch, being gently rotated at the same time outwards and upwards. In doing this it will for the most part easily slip into the trumpet-shaped orifice of the tube, and may be felt to be embraced by its walls. Or when the point of the catheter has arrived at the posterior nares, the instrument may be gently rotated outwards and slightly

[1 The reader is referred to page 190, in order to see the possible dangers attending such treatment.]

upwards, and carried on into the pharynx. In this way it may be passed directly into the Eustachian tube. The former plan, however, is the easier; and in the latter it is necessary to guard against entangling the point of the catheter in a lacuna which lies directly in its route. No bleeding should follow its use, unless there has been unusual resistance. Air may now be passed into the tympanum, either by an elastic bag or by means of a flexible tube, provided at one end with a mouthpiece, at the other with a small pipe fitting into the end of the catheter. The otoscope being placed, one end in the ear of the surgeon, and the other in that of the patient, the air, if it can be forced through the Eustachian tube, may be heard to pass into the tympanum and strike on the membrana tympani. The chief sources of failure in passing the Eustachian catheter are two: first, suffering the point of the instrument to slip up into the *middle* meatus, instead of sliding along the *floor of the lower;* and secondly, not drawing it far enough forward again after touching the posterior wall of the pharynx. In other words, if the instrument is wrongly placed, its point will generally be either too high up or too far in. Sometimes it happens that it slips some distance *down* the pharynx before being stopped by contact with its posterior wall, and in this case requires more than the average withdrawing. The distance between the orifice of the tube and the back of the pharynx is perceptibly greater in men than in women. Besides its use in closure of the tube, the catheter is constantly in requisition for the efficient diagnosis and treatment of disease within the tympanum, and facility in its application (which is not difficult) is indispensable to any who wish to be able really to relieve this class of affections. A very little practice on the recent section of a skull gives all the skill that is needed. The best form of catheter, I believe, is that constructed of vulcanite; various sizes and curves are desirable—the latter ranging from a very slight bend of the point to nearly a semicircle of an inch in diameter, for using through the opposite nostril in case that on the affected side should be impervious.

The only proofs that the catheter lies fairly in the tube, are hearing the air pass along the tube, or introducing a bougie, or observing its position by means of rhinoscopy. The latter, however, is seldom required, although an examination of the posterior nares and orifice of the tube by means of the mirror has added, and will no doubt add more, to our knowledge. It has exhibited, for example, ulcers of the mouth of the tube and incrustations of thick mucus over it, necrosed conditions of the adjacent bone, and complete obliteration of the orifice.

If air cannot be passed into the tympanum by means of the catheter, the tube may be opened by bougies. This proceeding is attended with a certain amount of pain, but with due caution it is free from serious danger, and by means of it very many otherwise incurable cases of deafness may be perfectly relieved. It is remarkable, indeed, how dense and how confirmed strictures of the tube may by perseverance be thus thoroughly and permanently overcome. Often, indeed, one, or at most three or four, introductions of a thin and very elastic bougie will suffice; but in other cases I have known a perseverance in their use, extending over many months, completely successful at last, and hearing restored with almost absolute perfection, where it had been absent for twenty years. In this case there existed also a collection of mucus within the tympanum, for which the membrane had been incised more than once, with only temporary benefit. When a stricture of great density exists, it is requisite to have recourse, very carefully, to whalebone bougies, and to laminaria, which may be suffered to remain in the tube five or ten minutes, the catheter and bougie being then withdrawn together. Two cases of laminaria bougies *breaking off* in the tube, are recorded by a German physician, but the fragments soon came away, leaving no ill effects. I have never found such an accident in the least degree threatened. But even in spite of care, slight abrasion of the mucous membrane will sometimes occur, and then if air be forcibly injected it becomes extravasated in the cellular tissue, and causes a swelling which naturally alarms the patient. With the least prudence, however, this accident is never formidable. The air is entirely absorbed in a day or two, and after a fortnight's rest, the treatment may be quite safely proceeded with.[1] An excellent addition to the use of bougies is to introduce through the ordinary catheter another very small elastic one (capable of entering the tympanum through a normal tube) as far as it can be passed, and then to syringe through it, with moderate force, a strong alkaline, or weak caustic solution —using as it were hydraulic pressure.

[1] It is my impression that a case of death after using the air-press, which made a great sensation in London some thirty years ago, and helped to throw Eustachian catheterism into very undeserved ill-repute, was due to extravasated air obstructing the larynx; but this cannot be made certain, and the evidence proves that the air was injected in a most rash and violent way, and apparently was entrusted to hands quite unskilled.

The inflation by Politzer's bag should be used concurrently; and by degrees a stricture that at first seemed hopeless will yield. When air has at length reached the tympanum, a few drops of a solution of nitrate of silver (gr. ij–vj ad ℥j) should be carefully syringed into it, and this may be repeated at intervals of two or three days if necessary, and if no severe pain ensues. [The introduction of any fluid medicament, and especially nitrate of silver, into the tympanic cavity, through the Eustachian catheter, is now abandoned by those of largest experience, because of its great likelihood to induce severe inflammation of the mucous membrane in the tube and tympanum.] The tube after a time remains pervious. In bad cases a daily introduction of the bougie is required; but it is needless to say that—unless in exceptional cases—neither this nor any other severe or prolonged treatment to the tympanum should be carried out unless the symptoms indicate that the nervous function is tolerably well maintained.

In syphilitic affections of the throat the Eustachian tube will sometimes become obstructed, but apparently much less frequently than might have been expected. Such cases seem to do perfectly well under a rational combination of the general and the local treatment.

Affections of the Tympanum and Mastoid Cells.

During the last few years considerable light has been thrown upon some of the affections of the tympanum. Among other points the diagnosis between deafness depending upon tympanic or nerve lesions has been greatly advanced. The chief means of distinction is the tuning-fork, used in certain ways; the only drawback to its value being the fact that a certain number of persons, otherwise of good hearing, are unable, or almost so, to hear it when placed upon the head. Allowing for this circumstance, which is not often of consequence, the following propositions may be laid down:—

1. That in a normal state a tuning-fork is heard before the meatus after it has ceased to be heard on the vertex.

2. That when placed on the vertex, it is heard more plainly when the external meatus is closed.

3. Consequently when one meatus alone is closed, the tuning-fork is heard most plainly in the closed ear.

The reason of this fact appears to be, that the sound escapes freely through the tympanum and meatus, and that when its passage is impeded the waves are reflected and affect the labyrinth more strongly. Consequently in cases of diseases the following inferences seem justified:—

1. In cases of one-sided deafness, if the tuning-fork, when placed on the vertex, is heard most plainly in the deaf, or more deaf ear, the cause is seated in the conducting apparatus; if it is heard loudest in the better ear, the cause is probably in some part of the nervous apparatus.

2. If, on closing the meatus, the tuning-fork is heard decidedly louder, there is no considerable impediment to the passage of sound through the tympanum.

3. If the tuning-fork is heard longer on the vertex than when placed close before the meatus, the cause of the deafness is in the conducting media.

4. However imperfectly the tuning-fork may be heard when placed on the vertex, it gives reason for suspecting only, and is not proof of, a nerve-affection.

Other conclusions also may be drawn from the use of the tuning-fork, but they are either corollaries of the foregoing, or are too doubtful to be of real value in practice; but those mentioned are of the greatest and most constant practical value. With few exceptions they enable us at once to distinguish between an affection of the receptive and of the conducting portions of the organ; and thus relieve us entirely from that which has been the great difficulty and discouragement in the treatment of diseases of the ear. I find it a good routine plan of examination to note in respect to the hearing, (1) the distance by the watch; (2) whether watch heard on head; (3) how long the tuning-fork is heard on the vertex—whether equal or not to some average standard, the surgeon's own hearing of it, for example; (4) whether the sound is heard alike on both sides, or on which side it is louder; (5) the effect of closing each meatus; (6) whether it is louder on the vertex or before the meatus. If the deafness is considerable, and the tuning-fork indicates a normal condition of the tympanum, as, *e. g.*, that it is heard longer before the meatus than on the vertex, that its sound when on the vertex is increased by closing the meatus, and that it is heard best on the *least* affected side, I infer a "nerve" affection. I have not found that the age of the patient materially affects these conclusions. Of course when thus assigned to the nervous system, the real nature of the affection remains altogether to be investigated, and it may in many cases have its real seat in parts altogether distinct from the ear, or in the tympanum itself, the impaired function of the nerve being entirely secondary.

[*Voice as a test.*—Vocal sounds are the best tests for hearing. Vowels are endowed with the greatest strength of tone, being heard and understood at a distance

at which all consonants are inaudible. Thus the broad A-sound is heard 360 paces, while double O is heard the least distinctly of all vowels, viz., 280 paces. Consonants frequently depend on accompanying vowels for distinct audibility. H is the weakest consonant sound pronounced without an attendant vowel. It is lost at a few paces. B is next in strength, Ba being heard further than Ha. B alone is heard 18 paces. The German Sch, very similar to the English Sh, is heard furthest of all consonants, 200 paces.

No sound-unit in testing hearing has ever been instituted. In the component sounds of speech a wide range of tests of different intensities and pitch is offered to the aurist, and such a numerous set of tests is needed in order to discover which sounds are best heard by an affected ear. One sound is not sufficient as a test, because an ear may be unable to hear that particular sound but comparatively good for hearing others. Hence the watch with one or two sounds is a very limited test, both on account of their unmusical nature and their fewness. Therefore, in order to test the hearing in any case, words should be chosen in a great variety, and repeated, either singly or thrown together without sense, so that the patient will not be led into guessing what is said by the context.]

The chief diseases to which the tympanum is liable are inflammation either of its mucous membrane or osseous walls, and the results of such inflammation, in the form of effusions or adhesions; rigidity of its lining membrane; deposits within its cavity or that of the mastoid cells; anchylosis either of the ossicula to each other or of the base of the stapes to the fenestra ovalis; and disconnection of the ossicula from each other, with or without caries.

Acute inflammation of the mucous membrane of the tympanum.—This affection may exist in very various forms, from that of a slight degree of pain in the ear and deafness, rapidly subsiding, to that of a most severe and dangerous disease. It may occur in apparently healthy persons, and is then generally attributed to cold; it often accompanies an attack of catarrh. The mildest forms, which might perhaps be distinguished under the name of congestion, are characterized by an aching pain felt deeply within the ear, and for the most part by noises of a buzzing character; the hearing is impaired, but less in first than in subsequent attacks. The membrana tympani may be found on inspection slightly vascular, and either retaining its transparency, or dull; the meatus is healthy. Inflammation of the tympanum is rather painful; the air enters naturally, or with a slight creaking sound. This affection becomes of serious consequence by recurrence; for though the attacks may soon subside, a repetition of them seems to be a frequent cause of confirmed deafness, probably by producing thickening and rigidity of the delicate mucous lining of the tympanum. The object to be aimed at in the treatment, is to subdue entirely the immediate symptoms, and to guard against a recurrence of the attacks. The former of the objects may be attained by simple antiphlogistic treatment: a leech or two below the meatus, a stimulating liniment, or a small portion of blistering-paper worn nightly on the mastoid process for a short time. Two or three drops of warm oil may be poured into the meatus night and morning. [The reader is referred to page 184 for learning the possible bad results from using oil in the ear.] Habitual cold sponging and friction, especially around the ears, should be recommended to patients liable to this affection; and care should be taken to keep the throat in a healthy state. It is desirable to pay especial attention to preventive measures in all these cases, since they present to us one of the most common and most baffling forms of deafness in the very process of its formation. It would probably be a useful plan, if such patients inflated the tympanum with warm vapor every evening for some days after an attack; and neither patient nor surgeon should be content unless the full normal hearing power be regained. It is very seldom that persons suffering under deafness care to continue treatment until hearing is complete, since a certain imperfection occasions no inconvenience; but such cases as these might well form an exception to the rule.

[It is now fully recognized that cold bathing, either in fresh or salt water, as indulged in very freely in the open air in summer time, involves some danger to the ears. The injury may arise either from the entrance of cold water through the auditory canal to the drum-head, and, if the latter be perforated, to the drum-cavity, or through the nares into the Eustachian tube and the middle ear. The former mode of excitation of inflammation is more likely to ensue upon prolonged swimming, with an occasional "ducking" of the head, while the latter is more likely to occur in those who dive head foremost, or in those who strangle from any cause.

While it is admitted that many bathers in cold water escape injury of their ears, it is well known that many sustain it, though the origin of the aural malady is usually explained in some other way. It is especially important, when the drum-membrane is perforated, that not a drop of cold water should enter the external ear,

because its admission into the cavity of the drum is sufficient to light up the old inflammation with redoubled vigor.

Should the membrana tympani and the drum-cavity escape inflammation from cold bathing, nevertheless, there may be set up a diffuse inflammation in the external ear, which may induce more or less tenderness and engorgement in the mastoid soft tissues. This latter form of inflammation will prove very painful and sometimes alarming, from its resemblance to an intra-mastoid disease. It should be borne in mind that any of the above-named forms of aural inflammation may be as easily induced from prolonged cold-water bathing in a bath-tub, or from a pumping on the head, as indulged in by boys and girls in summer time, as by river or surf-bathing.

Treatment.—The most rational plan would be to protect the external ear, when about to take a cold bath; and this can be most easily accomplished by tying small but efficient pads or plugs over the meatus. Stuffing anything into the meatus will not answer the demand, because it will be washed out. It has always seemed to the editor that the most efficient protection is gained by an ear-muff, made of oiled silk and fastened over the entire auricle, like the winter protection of felt or fur. In the former protector it might be necessary to make the elastic cord, which runs around the edge and holds the oiled cap about the auricle, somewhat tighter than the corresponding fastening in the winter ear-muff. Perhaps a surer way of holding the bathing ear-muff in place would be to fasten it by cords around the head and under the chin, as well as by the elastic cord about the auricle. But even this or any other protection will not render surf-bathing safe for any one who has had any aural disease, and especially if that disease has left a perforation in the membrana tympani.

If inflammation in the ear arise from cold bathing, it must be treated upon the general principles already laid down.]

A certain proportion of these cases no doubt result in the accumulation of mucus within the tympanum, as referred to hereafter.

The severer forms of acute inflammation of the mucous membrane of the tympanum are attended with intense pain, of a throbbing, darting, or bursting character, extending over the side of the head, often in the course of the nerves, and aggravated by swallowing or any other motions of the throat. There are loud and distressing noises, and the hearing is always greatly impaired; much fever too is present, and delirium often supervenes. These symptoms may either commence suddenly, in which case they generally follow exposure to cold or draught, or injudicious bathing; or they may gradually increase for two or three days, or the acute attack may supervene upon a state of chronic inflammation. On examination by the speculum, the meatus is generally found in a normal state, though it may be tender and tumid; the membrana tympani is sometimes actively congested and of a bright pink color, at others it is only slightly reddened, dull, and mottled; and the vascular and swollen mucous membrane may be discerned through its semi-transparent laminæ. The throat is almost always actively inflamed. The act of inflating the tympanum, or of swallowing with closed mouth and nose, is acutely painful; if air enters the tympanum, the sounds are a gurgling or a prolonged creaking. There is often great tenderness over the mastoid process and immediately in front of the tragus. The treatment is that which is indicated by the pathology of the disease. In the most severe cases venesection is recommended by some authors, or cupping behind the ears. Leeches freely applied around the ear, and at the same time, perhaps, to the nasal mucous membrane, give great relief; and these may be repeated if the severity of the symptoms does not abate. Fomentations, steaming, and poultices, with all of which sedatives may be combined, and which the feelings of the patient demand to be used very hot, may be constantly applied; while aperient and cooling medicines, and morphia, or morphia combined with hyoscyamus, etc., in full doses, to procure sleep, may be administered. Some cases will improve rapidly under remedies of this kind: in others the symptoms are more obstinate, and all authors unite in recommending the administration of mercury in the form of calomel and opium; a point on which I offer no opinion, not knowing any evidence by which the comparative progress of the disease, when these remedies are given or withheld, may be tested.

After a few days the severity of the pain generally diminishes, and in the most favorable cases the disease terminates either in resolution, or, when the secretion has been but slightly increased, in discharge through the Eustachian tube. In the latter case, the passage of the matter into the pharynx is often felt by the patient, and indications of it may sometimes be seen by the surgeon. When either of these events occurs—the resolution of the inflammation, or the discharge of matter by the Eustachian tube—the symptoms gradually subside. In time the organ may perfectly recover its normal appearance and function, though it is

generally several months before the restoration is complete. Continued stimulation around the ear, and inflation of the tympanum with steam containing the vapors of iodine, acetic ether, etc., may perhaps expedite this process. The use of alkaline solutions through the nose is almost always of value.

In another class of cases, the matter discharges itself through the membrana tympani. This also may result in perfect restoration. The ear should be kept clean by the free use of lotions, either alkaline, or of perchloride of mercury; or in the later stages, of sulphate of zinc, used as before described. Mild counter-irritation may be perseveringly maintained, and tonics, and possibly iodide of potassium administered, the general and local hygiene being also assiduously attended to.

[The ear should be kept well cleansed in this condition; but as the discharge diminishes the quantity of fluid and the frequency of washing or syringing the ear should be lessened, for too much moisture will surely favor the growth of exuberant granulations and polypi. Hence, when it is possible and practicable, the ear should be cleansed by mopping it with absorbent cotton and not by syringing.]

A case is related by Triquet of acute inflammation within the tympanum arising upon the disappearance of an eczematous affection of the skin. A blister was applied to the nape of the neck, and the blistered surface became the seat of a similar eruption, on the access of which the aural disease subsided. Acute inflammation of the tympanum may run on to caries of the bone, and secondary intracranial disease; but such effects are far more frequent in the chronic form of the disease. Paralysis of the portio dura nerve may also accompany it: but this complication does not generally require special treatment. When it remains after the aural inflammation appears to have been cured, galvanism is said to have been found useful; but a thorough examination of the tympanum should be made.

Accumulation of mucus within the tympanum.—This is one of the most frequent forms of disease of the ear, and in its after-consequences I am convinced one of the most frequent, and most irremediable causes of deafness. Happily it is, not only in its earlier stages, but even after it has existed for years, entirely curable, by the incision of the membrane and washing out the abnormal contents of the tympanum. When the shape and relations of this cavity are considered, and that it is subject to the very same affections as the adjacent mucous surfaces, it cannot be matter of surprise that under a great variety of circumstances collections of viscid and tenacious mucus should form in it, that can by no possibility escape by the Eustachian tube. Indeed, these aggregations of mucus are often so dense that they do not even gravitate to the lower part of the cavity, but cling about the heads of the ossicula, and cause the membrane to bulge or to become atrophied at the upper and posterior part. At other times they consist of a very thin fluid, which moves freely in the tympanum, and may be seen through the membrane to shift its position with the motions of the head. The patient will often complain of distinctly feeling something moving in the ear, and will acquire the habit of giving the head a peculiar shake with the view of moving it. In some cases I have found the collection to consist of two distinct portions—a thinner, escaping freely on incision of the membrane; and a thick tenacious residuum, the evacuation of which is a matter of considerable difficulty.

The most frequent cause of the condition is a severe attack, or repeated slighter attacks, of a common cold, and though it is by far more frequent in the young, it may exist at every age. In one patient of sixty-seven, incision of the membrane and evacuation of a tenacious matter gave satisfactory results. After the affection has continued for some time, the membrane becomes considerably changed; apparently from the pressure of the fluid, it loses its elasticity, and becomes thinned in certain parts, especially in the region of the stapes; and as the Eustachian tube is almost always closed, the membrane is often irregularly drawn in—in some cases even lying in contact with the inner wall of the tympanum, at other times it distinctly bulges, and generally, though not invariably, the light yellowish color of the mucus may be discerned through it. Sometimes bubbles of air may be seen outlined on the inner surface of the membrane. The diagnosis is generally easy, and is made chiefly by inspection of the membrane and inflation of the tympanum, either by the patient himself, by Politzer's process, or by the catheter; the air entering the tympanum with a distinctly moist sound, of various kinds. When the affection is in its first stage the membrane is red and vascular, often bulges considerably, and pain is present. The "ear-ache" of children, followed by discharge, even though it is slight and very soon over, I believe, is most frequently an affection of this kind. I have seen under such circumstances, a minute opening form in the membrane, discharge for three or four days, and close.

In quite recent cases the symptoms may entirely subside, the excessive secretion appearing to be gradually absorbed or escaping by a small orifice through the

membrane, under a treatment consisting merely of general management combined with counter-irritation and washing out of the throat; but even in these the question of incising the membrane, with a view either to save it from extensive ulceration or to guard against future obstruction of the tympanum, is one deserving careful investigation. But in confirmed cases, where there exists no inflammatory action, but merely a chronic or intermittent deafness, with liability to repeated colds, the one treatment that it is rational to apply, or that yields any permanent success, is to incise the membrane and by a free stream of liquid, as described under "Perforations of the Membrane," p. 188, thoroughly to cleanse out the tympanum. In a word, the case should be converted into one of perforation, and treated on the same principles. As a rule, the incision heals, even if it be syringed through daily, in four or five days, nor is it desirable to keep it open longer. Very often, however, more than one incision is required, and the amount of dense mucus that may be thus removed, even in cases when there has been no indication of any very excessive quantity, is often truly surprising, and can only be accounted for by supposing that it has been crammed into the mastoid cells and gradually makes its escape as the tympanum is cleared. It may sometimes be seized by a forceps, as it protrudes from the orifice after inflation of the tympanum, and drawn out as a viscid mass into the external meatus. I have removed in this way a mass twice the size of a marble, and with immediate, and so far permanent, restoration of the hearing, in a case of continually recurring deafness, extending over five years. Many of these cases may be temporarily greatly relieved by the inflation of the tympanum and other means, but they relapse again and again, and lapse finally, in my belief, into confirmed deafness, constituting, *e.g.*, probably the larger part of the cases of "thickening of the mucous membrane of the tympanum," and no inconsiderable section of those of "nervous deafness." The great importance of a really rational treatment of these cases lies, of course, in its prevention of incurable consequent mischief. The tendency of these mucous accumulations is to become more and more dry and tenacious—they may be traced, indeed, through stages of this drying process—until they come fatally to clog the passage of sound. And they appear to work more disastrously still, by exerting an influence upon the labyrinth, and destroying by degrees the perceptive as well as the conductive power of the organ. It is my belief that if this affection were always rightly treated in its earlier stages, at least a third of the cases of confirmed deafness would be averted.

In its later stages, when the mucus has become dried, the diagnosis is much more difficult, and indeed it must rest largely on the history and on general inference. The appearance of the membrane, however, is often a very considerable guide; a general whiteness, *e. g.*, or especially a white streak posteriorly, or a rim of white thickening at the upper part. In many of these cases, considered hitherto as "thickening," I have found the incision of the membrane, and washing out the cavity, of great service, especially if it is first prepared for by the repeated injection into it of solvent liquids, as described hereafter.

The mode of making the incision is very simple. I use a very small double-bladed knife with a thin handle, and make the incision (unless a special bulging indicates another spot) always behind and parallel to the malleus, between it and the incus, and carry it from near the upper border to near the lower. I seek especially to open the upper and posterior part of the tympanum, because I am convinced that it is there especially that the more viscid class of secretions chiefly collect, and it is there also that they are most mischievous. If the knife does not penetrate too deeply, there is no danger of dividing the chorda tympani. Once only have I noticed any symptoms due to this cause, viz., a tingling running down to the tongue during the incision, and a marked diminution both of taste and of general sensibility of that side of the tongue, passing off in a few days. In this case, however, a good deal of pain was complained of after the incision. I have said the incision heals in four or five days, and this is the case unless irritation should set in, as occurs now and then, in which case the healing is delayed perhaps for ten days or a fortnight. On each of the four days subsequent to the incision, if no irritation arises, I syringe a strong solution of soda through the tympanum by the meatus. On the fifth day the orifice is generally closed, but if it be not I suffer it to heal, and repeat the incision at the interval of a week or more if its repetition is indicated. Generally, if the case is a suitable one, an immediate improvement occurs. Sometimes the contrary is the case at first, even when the ultimate result is most satisfactory. Sometimes, of course, no benefit has ensued, and the hearing has been for a time considerably impaired; but I have not yet met with a case which I have been able to keep under observation, in which the original condition has not been after a few months completely regained. The proceeding

itself, with care, seldom seems to give any shock to the system: once only, in a child who had suffered from convulsions previously, did convulsions follow shortly after the incision of both membranes.[1] But I have found that whenever any decided treatment is used to the tympanum, in a certain number of cases the *meatus* becomes inflamed. This, though it exerts no injurious influence on the progress of the case, is exceedingly painful and discouraging. I know no way of avoiding it but great caution in the applications, nor does this always succeed. The pain subsides in a few days. Hot poppy fomentations, warm lotions of liq. opii sed. (℥v–xx ad ℥j), and ointments containing aconite, give most relief. An incision through the inflamed structures down to the bone, especially of the superior or posterior walls of the meatus, not only gives immediate relief to the pain, but is of great service to the original disease, especially when there have existed symptoms of cerebral irritation.

This method of treatment is of eminent use in a large number of cases in which general nervous derangement has coexisted with obscure feelings of distress connected with the ear and head. In such cases, if an excess of mucus exists within the tympanum, the evacuation of it often gives the greatest relief. And I have found, both in these and in other cases, the membrane extremely dense and resisting to the knife, showing that it had offered, through the effects of disease, an unnatural resistance to the escape of the retained secretion. This condition of the membrane appears to be scarcely less frequent in young children than in adults.

It is probable that not a few cases of incomplete deaf-dumbness originate in disease of the tympanum, attended with such hyper-secretion. Nor does it seem unreasonable to hope that a practice founded on this belief, and not too long delayed, might here and there, where the symptoms and history suggest this cause, yield satisfactory results.

The incision of the membrane is not usually severely painful; in some cases it is scarcely painful at all; in others it gives rise to feelings of sickness and prostration for a few minutes. If the membrane is inflamed and tender, however, it is acutely painful for the moment. The patient should be prepared to keep the head resolutely still for the few seconds the incision demands, but it should not be fixed, lest not being able to move *away* from the surgeon's hand, he should suddenly move towards it. This is a precaution I employ in all operations in the immediate vicinity of the membrane. In children anæsthesia is desirable. The nitrous oxide produces an amply long effect, but the child is apt to be restless under it. Chloroform [or ether] induces a more perfect stillness, and the syringing through the ear may be carried out before recovery. It is needless to say that any blood should first be carefully syringed out of the meatus. I generally advise a lotion containing soda and liq. opii to be poured (warm) into the ear twice a day until healing has taken place. If any irritation of the meatus exists, it is desirable to subdue it before making the incision, or at least to proceed very cautiously afterwards.

A peculiar inflammation of the tympanum also accompanies various febrile diseases, especially the zymotic diseases of childhood. In scarlatina it is especially frequent, but it occurs also in measles and in whooping-cough. I should suspect that it was common in croup, since in two fatal cases of that disease, which I examined, it was present in both. The tympanum becomes filled with pus or puriform mucus; its mucous membrane thick, red, and velvety, often so swollen as almost to fill the cavity, and it easily peels off from the bone; presenting in all these respects a marked contrast to its properties in health, when it is so thin and delicate as scarcely to be recognizable, and adheres with unusual firmness to the osseous walls of the cavity, to which it serves as a periosteum. The mastoid cells generally participate in the disease, and are also found full of fluid.

One peculiarity of this class of affections is, that they are apt to excite no attention. It is seldom that any indication, at least any one that would be observed by a person not on the watch for it, is given of the inflammatory action within the ear; and the first symptom that is noticed is a discharge from the meatus, which occurs, for the most part, only after irreparable injury has been done. Should it not, therefore, be a rule with the medical attendants of children suffering from any of this class of diseases to prove the absence of this affection of the tympanum, by examining the membrana tympani with the speculum and lamp, instead of assuming that it is not present unless palpable symptoms force it upon their notice? Such an examination, it seems to me, should be held imperative, at least in every case in which anomalous symptoms arise, and the patient's general condition seems worse than the progress of the disease might have given reason for expecting. The appearance presented by the membrana tympani is quite sufficient to determine the presence, the nature, and even the stage of the disease. The in-

[1] As an universal rule I apply any powerful local treatment only to one ear at a time, and to the worse first.

flammatory action commencing *within* the tympanum, the external layers of the membrana tympani retain their transparency, and permit either the opaque fluid or the thickened and congested mucous lamina of the membrane itself to be clearly distinguished through them. This is an appearance which, once seen, can hardly be mistaken. In the early stage of the affection the membrane presents an increased concavity, owing, I presume, to closure, by thickening of its lining, of the Eustachian tube; and there is often no other alteration in its appearance, except a bright pink color seen *through* it. In the later stages the membrana tympani grows flat, it is dull and sodden in its hue, and at length manifestly bulges outwards before the accumulated secretion. The treatment would be guided by circumstances. In the slighter cases it might be possible, by antiphlogistic means, to subdue or check the local inflammatory action. In patients prostrate from severe scarlatina, or the like, it might be hopeless to attempt this, but excellent results might probably be expected from incision of the membrane. If, as in a case mentioned by Abercrombie, a discharge of matter from the ear restored to health a woman who had lost consciousness, might it not preserve from death a child depressed already to the lowest point by the poison of scarlatina? Might not such a patient's tenderer brain and feebler powers succumb entirely to a source of irritation which could produce symptoms so grave in an adult unaffected by other disease? I do not hesitate to avow my conviction, that by a prompt attention to the condition of the ear, and prompt evacuation of pus from the tympanum when evidence was given of its presence there, the balance might often be turned between life and death, and the mortality from scarlet fever and the allied disorders notably diminished. What else does the following report indicate?

A girl, aged eight, died in convulsions after scarlatina. No important disease was found, but the tympanum on each side was full of purulent matter, the membranæ tympani slightly bulging. It is true the urine was albuminous; but is it not so in very many cases of scarlet fever that recover? There was no decided disease in the kidneys. A case is reported by Mr. Harvey,[1] in which the evacuation of matter from the tympanum in acute scarlatina seemed to be attended with the best results. I have met with a case, a child aged five years, who had been deaf since the measles, two years before, in whom a mild attack of scarlatina very considerably improved the hearing. The membranæ tympani in this case were normal. In another case, of chronic deafness in a man aged thirty, scarlatina produced a similar effect.

[1] The Ear in Health and Disease, p. 101.

Deafness often supervenes in the course of typhus or typhoid fever. In some of these cases it seems to be due to a peculiar form of inflammation of the tympanum. The cavity becomes the seat of a sanguineous effusion, which is found after death either in a fluid or coagulated state. The mucous membrane seems at the same time disorganized, and the osseous walls may be soft and infiltrated with red fluid. A considerable proportion of the cases of confirmed deafness met with after fever, are probably of this kind; but not all of them. For sometimes the tympanum is found quite healthy, and the cochlea, or vestibule, or both, contain an effusion of bloody fluid; sometimes no appreciable alteration of any part of the organ is found, though the loss of hearing has been complete.

A collection of puriform mucus is found so frequently in infants after death, that it seems to have given rise to the opinion that the tympanum, during the first period of life, is naturally filled with mucus, and that children only begin to gain the faculty of hearing about the third month. I have convinced myself, however, by repeated dissections, that the tympanic cavity is, in the healthy state, quite free from mucus, and that the membrane lining it is thin and delicate, at the very earliest periods. But in a large number of children, especially those suffering from other affections of the mucous membranes, and particularly of the lungs, the lining membrane of the tympanum is thick, red, and soft, and the cavity is filled with mucus, often of a purulent character; the Eustachian tube, by reason of its thickened lining, being impervious to the fluid. The condition, in short, precisely resembles that which occurs in scarlatina, except that it is less intense and comes on less rapidly; and the membrana tympani exhibits, on inspection, a similar appearance. I have so frequently found this state of the tympanum, in children, associated with convulsions or other symptoms of cerebral irritation, that I believe it stands to them in the relation of a cause. And if the pressure of a tooth upon the gum may so act upon the delicate nervous system of a child as to cause convulsive seizures, surely it is not improbable that the pressure of a mass of thick mucus, unable to escape from the tympanum, and probably being constantly increased in quantity even through its own irritation, might have the same effect. The intimate relation of the middle ear to the brain, and the close sympathy that exists between

them, is proved by many well-known facts. Even a stream of cold water, applied without force to the membrana tympani, may cause fainting in a strong man.[1]

Cases illustrative of the coexistence of convulsive disease in children with the above-described condition of the tympanum, are related in the 39th volume of the Medico-Chirurgical Transactions, and in the Transactions of the Pathological Society for 1857. Perhaps it would not be unreasonable that whenever a child has a fit, or manifests any symptoms of nervous irritation without an obviously sufficient cause, the state of the tympanum should be examined: in short, that the ear should receive the same attention that is universally given to the gums. This is the more necessary beause the symptoms of this morbid condition are very apt to escape observation; those which I have noticed to be most frequent are a habit of putting the hands to the ears, or rubbing them; a cry of real pain when the ears are roughly washed; pleasure taken in having the meatus gently irritated, as by the head of a pin. In these, as in all cases of cerebral irritation, the child cannot bear to be jumped or otherwise violently moved. In one instance the child had been noticed to throw himself upon the ground and roll about, apparently in play, yet so strangely as to attract particular attention. The habit of rubbing the ears seems the most constant symptom, and one to which (as in the parallel case of dental irritation) special attention should be paid. These patients are sometimes noticed to be deaf; more frequently, especially among the poor, not so. Often they are thought to be stupid or inattentive. And here I cannot refrain from observing how frequently this is the case with children who labor under incipient deafness, and how strong a claim they have upon the surgeon to stand between them and their ill-judging guardians, and save them from the grievous wrong and injury that are too often inflicted upon them, under the idea that what is truly due to a physical infirmity results from moral fault. Too often blows are inflicted as punishment, which directly aggravate the disease. In the case of a youth who died with caries of the petrous bone and abscess in the cerebrum, and in whom the symptoms of aural disease dated from early life, his father had been in the habit of boxing his ears for "inattention."

In the treatment of this class of cases, incision of the membrane should doubtless be insisted on, but I have had less opportunity of testing its effect. They are for the most part seen only by the ordinary medical attendant, and no advice is sought for the ears. Attention to the general health and to the condition of the fauces of course are necessary, and I have thought also that the application of the tincture of iodine to the neighborhood of the ear, and the internal administration of the syrup of the iodide of iron, have acted favorably.

[Inflations of the Eustachian tube and tympana, would greatly advance the cure in these cases.]

Inflammatory thickening and hypertrophy of the mucous membrane of the tympanum are met with, for the most part, in connection with destruction, more or less complete, of the membrana tympani. Sometimes, though more rarely, they exist while the membrana tympani is perfect, being due in all probability to repeated attacks of subacute inflammation, especially in a strumous, gouty, or rheumatic constitution. The membrane is red, soft, and velvety, and may be so tumid as nearly to obliterate the cavity. The membrana tympani is more or less fallen in, opaque, thickened, and with a slightly reddish hue; congested vessels may be visible on its surface. The Eustachian tube is obstructed, or air enters with a creaking sound, as if forcing its way through an almost obliterated passage. The diagnosis, however, is difficult; the prognosis not favorable. Besides the ordinary local and general measures, small doses of the bichloride or biniodide of mercury may be given, in bark, or combined with the iodide of iron, and of potassium, for a considerable period; or any medicines adapted to combat the rheumatic habit, if it be evidently present. Too much stress, however, cannot be laid upon the regulation of the mode of life. A careful diet, exercise, avoidance of close atmospheres or sudden variations of temperature, may at least delay the progress of the disease.

Syphilitic inflammation of the tympanum.—It cannot be doubted that deafness is sometimes due to syphilitic affections of the middle ear; but these cases are rather to be distinguished by the history than by the condition of the organ.

[*Sudden Deafness of Syphilis.*—Much attention has been lately given to the so-called *sudden* deafness of syphilis. The seat of the lesion in these cases has been differently located by the best authorities, some inclining towards a purely labyrinthine lesion, a cochlitis, while Buck,[1]

[1] Convulsions are enumerated among the causes of deaf-dumbness; but there is every reason to believe that in some of these cases the connection of events lies the other way, and disease in the tympanum has been the cause of the convulsions.

[1] American Journal of Otology, vol. i., p. 39.]

Sexton,[1] Bumstead,[2] Sturgis,[3] and others, are disposed to believe that the phenomenon is usually due to lesions often circumscribed in the conducting apparatus. It is for us simply to bear in mind that in such cases a sudden deafness is developed in one or both ears, which, while presenting more or less clear symptoms of middle ear disease, yields, if taken in time, to purely anti-syphilitic, constitutional remedies.

The treatment has consisted in inunctions of the oleate of mercury, and the internal administration of $\frac{1}{32}$–$\frac{1}{16}$ gr. bichloride of mercury, either with or without 5 to 10 gr. of iodide of potash thrice daily.]

Deposits within the tympanum.—Cholesterine is sometimes found in this cavity and in the mastoid cells in considerable masses; chiefly in advanced life. Another form of deposit, which occurs for the most part in the young, is probably of a tuberculous character; it is a soft caseous mass, consisting of degenerated cells and granular matter. In these latter cases there is most frequently a secondary or coincident affection of the brain. Dr. Gull[4] questions whether these deposits are of a strumous character, and holds that they consist simply of inspissated and degenerated pus. The coincident affection of the petrous bone seldom presents the characters of strumous infiltration, but rather those of ordinary caries. Yet cases occur in which the tubercular character of the affection can hardly be doubted; for example, where tubercle exists also in the lungs, or where, as in a case reported in vol. xxxix. of the Medico-Chirurgical Transactions, tubercular masses, of a similar character, exist in the tympanum and the adjacent portions of the brain. In the case of strumous deposit within the tympanum, the membrana tympani generally ulcerates, and exposes the cavity. The treatment naturally suggests itself; but it is of course doubtful whether any treatment could be of avail. In the latter stages of phthisis ulceration of the membrana tympani is a frequent symptom.

Membranous bands, extending between different parts of the tympanum, and connecting the ossicula to each other or to the walls of the cavity, are frequently met with after death. Respecting these I have made two observations, which appear to me to be of interest. The first is, that mere mucus in the tympanum, if exposed to the air in a dissected petrous bone, will in the course of a few days dry up into broad bands, undistinguishable by the eye from those which are so frequently met with. It is true the "bands" thus formed present no structure under the microscope, while some of the membranous adhesions which are found already existing on dissection have a fibrillated appearance. Yet it seems probable to me that mucus may dry up within the tympanum during life, and may thus give rise to the appearance of bands in some cases. I am induced to hold this opinion from the extreme frequency with which these membranous bands are found. Bands were present in 271 out of 1149 dissections of diseased ears made by Mr. Toynbee, and in 30 out of 94 such dissections made by myself. They occur also in cases in which there is no other appearance of inflammation, and indeed where the probability is very strong that it has never existed. I have found a very broad and distinct band in the mastoid cells of an infant four months old. It is hard to understand how real fibrinous adhesions should form in such a cavity as the tympanum without the effusion of a considerable quantity of lymph, which must involve, one would suppose, an attack of inflammation of a formidable kind. I have observed, also, that membranous bands in the tympanum do not seem to affect the hearing to an inconvenient degree, unless they also interfere with the motions of the ossicula.

An irregular concavity of the membrana tympani, the Eustachian tube being pervious, may give ground for suspecting the presence of such bands, which will be rendered more probable if there be a history of previous inflammation. But a little instrument introduced by Dr. Siegle, and termed by him the "pneumatic speculum," renders their detection, when they exist to any serious degree, more easy. This instrument consists of a small box, having a slightly magnifying lens for one end, and at the other terminating in a speculum which is made to fit the meatus air-tight by means of a piece of elastic tubing placed over it. From the box there passes off also a tube ending in a mouth-piece. If, now, having adapted the instrument to the meatus, the surgeon applies suction by the tube, and at the same time keeps his eye fixed upon the membrane through the lens, it will be seen to move outwards, and may be made by modifying the air-pressure to move to and fro. If it is bound down by adhesions these will reveal their presence by their interference with its movements. They are by no means an insuperable cause of deafness. Not seldom they may be ruptured by a powerful inflation of the tympanum on Politzer's plan. The patient

[1] American Journal of Otology, vol. ii., pp. 301–309.]

[2] As quoted by Dr. Sexton, loc. cit.]

[3] F. R. Sturgis. Boston Med. and Surg. Journal, June 3, 1880.]

[4] Guy's Hospital Reports, vol. xxxvii.

feels a sudden snap in the ear, and at once hears better (for the most part), and on examining the membrane a distinct effusion of blood on its inner surface may be seen, which is absorbed in a few days. The inflation needs to be carefully continued. In other cases, if the nervous power is preserved, injection of the tympanum with solvent fluids, as described under "Rigidity of the mucous membrane," is often useful. The same means, combined with the use of the catheter and bougies to the Eustachian tube until it is freely pervious, are efficacious also in some of these cases in which there exists more or less complete disorganization of the tympanum from the effects of former inflammation, and the membrana tympani, though not perforated, is fallen in and lies in contact, or nearly so, with the promontory, while the soft structures are infiltrated with hardened secretion, and converted into dense and rigid masses. The power of hearing, in some of these patients, is greater than the condition of the visible portion of the ear would lead us to anticipate; and even the worst cases need not always be entirely abandoned. It is often the case that when one ear is much less sensitive than the other, the patient acquires the habit of entirely disusing it, and of relying solely upon the better organ. Thus the function of the injured ear becomes deadened from mere lack of exercise, and it is capable of being roused by use to greatly increased sensibility. Sometimes persons who have thus suffered one ear to fall into disuse, are unfortunate enough to meet with an accident, or suffer a disease, which destroys the other, and then they may obtain great relief by bringing into use the latent powers of the neglected organ. By means of a hearing-trumpet, or sometimes without it, an ear long supposed useless may be brought, through persevering exercise, to play a very serviceable part. On the same ground, it should be a rule with the surgeon to encourage those who have sustained irreparable injury to one ear, short of total deafness, to maintain it in exercise by using it alone for a certain period every day. Those also, by whom hearing can be performed only with difficulty through disease of both ears, should be instructed to exercise what power may remain, instead of relying on the sight alone; and their friends should be willing to aid them in this endeavor.

Rigidity of the mucous membrane of the tympanum.—I retain this expression, though I feel that at present its signification must be held quite doubtful. It is not unlikely that the rigidity of the membrane may arise, in the large majority of cases, from the gradual drying of retained secretion. But the data are not yet available for determining this point, nor is it, at least in confirmed cases, of practical importance. Whether the mucous membrane be, according to Mr. Toynbee's view, "rigid" from slow inflammatory or degenerative action, or be rendered so by condensed secretion, the effect doubtless in impairing the motions of the ossicula is the same; and so also is the treatment. If there be vigor in the patient's constitution, and the nervous power seems to be moderately well maintained (as *e. g.*, if the tuning-fork be better heard in the *worse* ear), benefit is generally derived from the continued injection of solvent or astringent liquids into the tympanum. [The caution given on p. 190 must be repeated and insisted on here.]

There is one qualification to this remark, however, viz., that when a true bony anchylosis of the stapes exists, benefit cannot be expected, and I do not know any symptoms by which it can certainly be distinguished during life. I believe, however, from the result of my dissections, that this is a decidedly rare affection except in the aged, and, I think, that symptoms of nerve-failure generally accompany it. In cases of "rigidity," the meatus is frequently found devoid of cerumen; the membrana tympani is either natural or slightly opaque; occasionally it may contain calcareous deposits. The Eustachian tube is pervious; and the air enters often with a loud or a wheezing sound. No pain is present; but there is generally an annoying tinnitus. The "adapting power" of the organ is more affected than the mere ability to distinguish sounds. The patient is embarrassed in general conversation, while able to hear single voices with tolerable ease. This symptom, however, may also exist in cases of nervous deafness, arising from the excitement connected with a large company; but the mode of its production is different; and in the latter cases excitement produces the same effect under all circumstances. Hearing better in a noise, as while riding in a carriage or during the beating of a drum, appears to be common to this with some other morbid conditions.

It has been recommended to treat this affection with counter-irritants, nitrate of silver applied to the membrana tympani, baths, and inflation of the tympanum with medicated vapors. But, I believe, the only plan which is at all reliable, is to inject at short intervals into the tympanum medicated solutions. Those which I chiefly use are carbonate of soda (gr. x –xx ad ℥j), hydrochlorate of ammonia gr. x ad ℥j, with which I usually combine perchlorate of mercury (gr. ⅛); and sulphate of zinc, gr. ij–vj ad ℥j;—the first as a mere solvent the second as stimulating and absorbent, and the last as an astringent. But

various others, as liq. potassæ, tinct. iodinii, and arg. nitr. in small quantities, are recommended, and probably have special advantages in some cases.

There are two ways in which they may be applied; the best is to introduce a few drops by means of the Eustachian catheter, through which it is easily blown into the tympanum by an elastic bag. This may be done from once to three times a week, and continued for three or four weeks. If it is beneficial it can be resumed at intervals. At the same time friction with iodine and ammonia, or occasional blisters, can be employed; and the throat should be kept clear by solution of soda drawn or syringed through the nostrils. Many cases that would otherwise have been hopeless, may by this means be very greatly improved. It requires of course the continued attendance of the patient, and when this is impossible, or seems not justified by the probability of benefit, this may be dispensed with (although not without some disadvantage), and he may himself force a solution of soda or ammon. hydrochl. into his own tympanum once or twice a week. The method of doing this is very simple, and was first pointed out by Dr. Gruber, of Vienna. The patient, inclining his head well to the affected side, introduces into the nostril of the same side a glass syringe containing about ʒij of the solution. This he syringes firmly into the pharynx, where it lies in contact with the orifice of the tube. He then quietly and without swallowing inflates the tympanum. With a little practice he thus quite easily forces a little of the fluid into the tympanum. If the tube be not pervious, of course it must first be made so, and before this plan is adopted, it is well to clear the posterior nares and pharynx well by a solution of soda, through the nose, twice daily for a week. There is more risk of irritation on this plan, but I have known it also answer very satisfactorily, and in cases of long standing.

Warm vapors containing iodine, etc., introduced through the Eustachian catheter, by means of an air press or an elastic bag, though less useful, appear sometimes efficacious, and often form a valuable adjunct. But *the* remedy is liquids.

Dr. Weber-Liel, of Berlin, has suggested the introduction of a very small elastic tube through the ordinary catheter, quite into the tympanum—a proceeding perfectly feasible—and by means of it the direction of a stream of medicated spray to any desired region of the tympanum. By this means much stronger solutions may be employed with safety, but perhaps the difficulty of deciding when and at what point they are required, will for some time remain.

In some obstinate cases I have seemed to find benefit from the biniodide of mercury (gr. $\frac{1}{32}$), combined with syr. ferri iodidi, ʒj, and potass. iod., gr. ij, ter die, continued for some weeks. As a rule I use the solutions only to one ear at a time, and having thus a point of comparison, I have been able to convince myself of their benefit in some cases in which, at the patient's own request, they have been employed at intervals for upwards of two years. But I think no skill in diagnosis can, with our present knowledge, avoid failures; especially, perhaps, in young women, who, as a class, are very liable to this or some like form of deafness. General tonic regimen and especial avoidance of close rooms and other causes of catarrh, and also of the too free use of cold water to the head, are of course to be insisted on.

This form of disease, together with that next to be mentioned, has been ascribed to a gouty or rheumatic constitution. On this point, however, farther investigation may be needed. Dr. Garrod informs me that he does not find gouty or rheumatic patients especially liable to deafness, the ear forming in this respect a decided contrast to the eye; and Dr. Gull has submitted to examination some deposits from the tympanum supposed to contain acicular crystals or uric acid, and has found them to consist of fat.[1] The best marked case of the connection of deafness with the gouty diathesis that has come under my own observation is that of a lady, aged fifty-seven, subject to attacks of gout and slightly deaf. On the occasion of the sudden death of her husband, an intense deafness came on in the course of a few hours, which subsided on the local manifestation of gout two or three days afterwards.

Anchylosis of the stapes to the fenestra ovalis.—This is an affection our chief knowledge of which we owe to Mr. Toynbee. It consists in a union, by bone, between the base of the stapes and the margin of the fenestra ovalis. This condition may exist in various forms, either that of a simple expansion of the base of the stapes, or an expansion combined with a calcareous whiteness of the bone, or with effusion of osseous matter within or around the joint. In some cases, there is found a thickening and rigidity merely of the ligaments connecting the articulating surfaces. The general symptoms are very like those of the last-mentioned affection. How far treatment is of any effect, there is as yet no sufficient evidence to show.

In Canstatt's Jahresbericht for 1859 is an account of a paper by Voltolini on this subject. Taking into consideration the very

[1] Guy's Hospital Reports, 1857, p. 289.

slight amount of motion normally possessed by the stapedio-vestibular articulation, it appeared to him unlikely that the deafness which occurs in its anchylosed condition could arise from its immobility. Experimenting upon the subject, he found that vibrations were transmitted best from air to a limited surface of water, when the latter was covered by a plate, which was not solidly connected to the boundaries of the aperture. It is to the alteration in this respect, therefore, and not to loss of the motion which might be given to it by the muscles of the tympanum, that he ascribes the deafness which accompanies osseous anchylosis of the stapes. In respect to the diagnosis, he rejects the relatively greater inability to understand mixed conversation than to distinguish single sounds, and relies chiefly on the appearance of the external portions of the ear: the meatus dry, widened, without vital reaction, and leathery; the membrana tympani parchment-like, dry, thick, opaque, sometimes with earthy deposits, and immobile. The affection occurs, too, in dry and harsh constitutions. The sound, on inflation of the Eustachian tube, is normal, or too full, and the act produces no improvement. He rejects all treatment.

In connection with this affection, Mr. Toynbee has reported a case in which a great temporary improvement was effected by a loud shout uttered close to the ear; this improvement being ascribed by him to a loosening of the stapes within its articulation. Perhaps the following case, related by Triquet, was one of a similar nature. A man had suffered from deafness, coming on gradually for many years, without any known cause. It was attended with tinnitus. In a fit of despondency he fired a pistol into the right ear. The bullet destroyed the auricle and fractured the meatus, passing out beneath the scalp. The hearing in that ear was raised by the shock from two to twelve centimetres. I have also seen a gentleman in whom deafness of several months' standing suddenly ceased on an engine passing close to him with a loud whistle. The ear in this case (some years subsequently) showed nothing abnormal.

Indeed, the causes which will sometimes seem to improve the hearing in cases of deafness are such as we could by no means anticipate. An elderly lady, who had been under my care for deafness, attended with perforation of the membrana tympani, was seized with paraplegia. The hearing became decidedly better at the time of the attack, and continued so for some years.

Exostoses, or deposits of osseous matter, are occasionally found on the other ossicles.

One case also is on record of *fracture* of the handle of the malleus. It was found in the body of a man who died in Guy's Hospital from disease quite unconnected with the ear, and is reported in the Pathological Transactions, vol. x., p. 236. The fracture took place just above the processus brevis, at the point where the tensor tympani ligament is attached; the fractured surface was smooth and convex, and seemed to have played on a false joint upon the body of the malleus, which was displaced inwards. I have seen another also, produced by a sudden blow while picking the ear with a wire. The deafness was very great.

Dislocation of the ossicula is more frequent; it generally occurs between the incus and stapes, and is accompanied with caries of the bones, or other effects of inflammation. In the severer forms of inflammation of the mucous membrane of the tympanum, indeed, caries of these bones is not an unfrequent result. For the most part, when this occurs, the membrana tympani is perforated; but this is not always the case. The head of the malleus, the incus, and one crus of the stapes, have been found to be destroyed by caries, the membrane being entire.[1] The patient was a woman aged thirty, who died of acute peritonitis. The artificial membrane is suitable for these cases.

In cases of perforation the incus frequently comes away in a more or less carious state; the malleus also, but less frequently; and still more rarely, the stapes may be separated from its attachments and cast off. Whether total deafness necessarily results from loss of the stapes, involving as it must do the discharge of the perilymph from the internal ear, is as yet undecided.

Diseases of the Mastoid Cells.

Besides participating, as they for the most part do, in inflammatory diseases of the tympanum, the mastoid cells are subject to affections which do not involve that cavity. They may be the seat, for example, of deposits, chiefly of cholesterine, while the tympanum is free; and inflammation leading to caries or necrosis of their osseous walls may coexist, though seldom, with a comparatively healthy state of the adjacent parts. This latter affection is more frequent in childhood than in adult life, and, whether consequent upon disease commencing in the tympanum or not, demands prompt measures to prevent extension of the mischief to the intra-cranial organs. The symptoms are, tenderness over the mastoid process, followed by redness and tumefaction; a discharge generally issues from the meatus, although the walls of this passage may be perfect. Sometimes an obscure fluctuation may be felt behind the ear. There is generally at this stage of the disease headache, and pain extend-

[1] Triquet, from the Gaz. des Hôp., Jan., 1851.

ing over the back of the head and neck; often giddiness, and other symptoms of irritation of the brain. The most essential point in the treatment is not to neglect, nor to defer too long, an incision, freely exposing the bone. This should be made in the vertical direction about half an inch behind the ear, and should extend the whole length of the mastoid process. Great relief almost invariably follows. Sometimes pus will escape, and the knife will penetrate the softened bone. Poultices should be applied, and a free discharge encouraged. Portions of dead bone may come away, or the wound may gradually heal without exfoliation. If the cerebral irritation should continue, a seton applied to the nape of the neck, or an issue in the arm, may be found useful, the utmost care being at the same time taken to insure a free exit of matter. There are now nearly twenty cases on record in which the mastoid process has been trephined, or otherwise perforated, for the evacuation of matter contained within it. Of these it may be said that almost every one appears to have been successful that was not performed too late. The operation is a simple one, and by aid of the instruments (Fig. 292) may be carried out with great safety. It should never be neglected when, after the periosteum covering the mastoid process has been freely divided, symptoms of cerebral irritation still continue.

[*Other modes of perforating the mastoid portion.*—After the patient has been thoroughly etherized, let an incision be made about half an inch behind the auricle, beginning on a line with the top of the auricle. In many instances the surgeon may be surprised at the thickness of the tissues over the mastoid, and the depth to which he must cut before the bone is reached. The bleeding, which is usually quite profuse, will be advantageous to the engorged parts. If an arteriole is cut, the hemorrhage must be controlled of course by a ligature, when the wound may be sponged and the bone examined. This may be so soft as to yield readily to the pressure of a probe or a knife-blade. The latter should not be longer than from 5 to 8 millimetres, for fear of penetrating too far with it, and hence a short, thick-bladed knife, as represented in Fig. 291, is preferable.

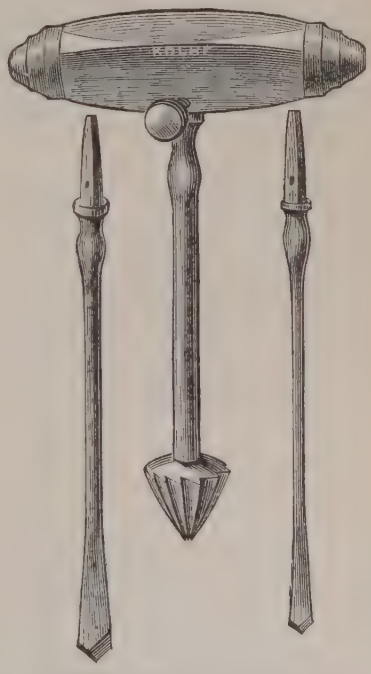
Fig. 291.

Knife for opening mastoid abscess.

If after the incision through the soft tissues, as above described, and the dissection of the periosteum, the bone is found healthy on its outer surface, and resistant to pressure from a probe or a knife, it may be required to be opened by means of small trephines, bits, various kinds of chisels, drills, etc. Very good forms are those recommended and used by Dr. A. H. Buck, as shown in Fig. 292.

If pus be found beneath the periosteum, a sinuous opening in the mastoid may be suspected and should be sought for. If such an opening is found, the perforator may be applied here and the existing hole made larger. If, however, the operator may choose the point for perforating the mastoid surface, it should be about a quarter of an inch behind the external auditory meatus, a little below the level of the upper wall of the canal. If the line of the zygoma and the temporal ridge be extended posteriorly until it intersects a perpendicular drawn through the mastoid tip, the angle lying between these lines, on the side towards the external auditory meatus, will indicate the posi-

Fig. 292.



Instruments for perforation of the mastoid cells.

tion for the insertion of the perforator. A few turns of the pyramidal borer, in a direction inward, forward, and slightly upward, will usually be sufficient to perforate the mastoid wall, the average thickness of which at this point is about one-fifth of an inch. The opening thus made may be further and definitely enlarged by the use of a bit, such as is represented in Fig. 292.

Retractors made of steel wire will be found of service in keeping the edges of the cut away from the operator. They must of course be entrusted to a careful assistant.

After the mastoid cells are thus exposed, they may be broken up by means of a firm probe, and the mastoid antrum thus reached.

The gouge is preferred by some operators for perforating the mastoid wall. Such an instrument may be of value in hyperostosis of the mastoid wall, for, as has been shown by Schwartze, of Halle, by employing it the cells may be bared and the mastoid antrum reached by the successive removal of layers from the outer mastoid wall. Although the pain may have been intense and unyielding, and the symptoms of the patient strongly indicative of cerebral complication, the perforation of the mastoid may not give vent to pus, but to a reddish, pulpy matter. The operation, however, will give the desired relief and cut short a process which would have rapidly advanced to suppuration, with all its tendencies to burrow towards the brain. If this operation is but honestly and fairly regarded, in the light of recent investigations, it must be admitted that it is simple, safe, and efficient. It becomes, therefore, the duty of every conscientious practitioner of medicine to be carefully observant of the onset of an inflammation in the mastoid cavity, and prompt to relieve it. By such intelligent action life will as surely be saved as heretofore it has been lost, because the true nature of mastoid disease has not been recognized, and consequently no rational means resorted to.]

Diseases of the Ear implicating the Brain or Lateral Sinus.

This fatal class of diseases has been long recognized, but much additional light has been thrown upon their pathology by the investigations of Mr. Toynbee and Dr. Gull. The former has shown that inflammation of any portion of the ear, either of the meatus, tympanum, the mastoid cells or labyrinth, may extend to the bone, and lead to a fatal issue; and has established it also as a general rule that disease advancing from either of these portions of the organ sets up morbid action in certain definite localities within the cranium. Thus inflammation of the meatus or mastoid cells tends to produce disease of the lateral sinus or cerebellum, except in young children, in whom the mastoid cells are very small, and are in relation rather with the cerebrum. Inflammation of the tympanum for the most part extends towards the middle cerebral lobe; and when the labyrinth is involved, which seldom happens except by extension from the tympanum, the progress of the disease takes the course of the auditory nerve towards the medulla oblongata. Other observers, while allowing the great exactness and importance of the relations thus pointed out, have held that exceptions occur, and that disease, commencing in any portion of the ear, may progress inwards by various routes.

The chief secondary diseases produced by aural inflammation are three: inflammation of the dura mater and the other membranes; abscess in the substance of the brain; and inflammation of the lateral sinus, with its effects. The two former of these affections are for the most part found together; but cases not unfrequently occur in which, while the dura mater is inflamed, the cerebral tissues exhibit scarcely any appreciable alteration; or, on the other hand, in which one or more abscesses exist within the brain, while the dura mater appears healthy. Besides these cases of demonstrable secondary disease resulting from inflammation within the ear, instances occur in which death takes place with symptoms of cerebral affection, but in which no lesion whatever is found except within the tympanum.

The early symptoms of implication of the brain are rigors, often at first resembling attacks of ague (so that they have been treated with quinine); and pain in the head, gradually becoming intolerably severe. This pain for the most part extends over the back of the neck, and it is greatly increased by motion. Delirium, impairment of consciousness, of speech, or of muscular power may ensue, and death follows, the pain generally being intense until the last. The sudden cessation of a chronic discharge from the meatus, accompanied by pain and fever, frequently marks the onset, or at least the threatening of an internal inflammation.

The symptoms, however, are not always of this acute character. As in other forms of abscess within the brain, there may exist for a considerable period scarcely any indications of the serious mischief that has taken place. Treatment, in this affection, is of avail to save

life only in the earliest stages. When suppuration is established within the brain, and there exists a diseased bone in its immediate vicinity acting as a constant source of irritation, it is probably vain to hope to do more than alleviate the sufferings of the patient. The first and main indication in all cases is to obtain and preserve a perfectly free exit for matter. A case is reported by Dr. Gull, in which though it issued fatally, a decided mitigation of the symptoms followed a discharge of matter through the nose; and an indication is thus afforded of the surgeon's chief task in every instance of this affection. Perforation of the membrana tympani, if it be entire; or its incision, if by adhesion to the promontory or otherwise it act the part of a valve; or trephining of the mastoid process, should be had recourse to, and promptly if necessary, to avert the retention of pus. In some cases polypi seem to obstruct the meatus; and then their removal becomes a matter of the utmost importance. A case is related by Bonnafont, in which the crushing of a polypus gave exit to a large quantity of matter, with immediate relief to the gravest cerebral symptoms, and others have occurred in my own experience.

When inflammation extends from the ear to the lateral sinus, it proves fatal by secondary disease of the lungs, which become affected with lobular pneumonia and pleurisy; pneumo-thorax also, and sloughing of the lung, frequently occur. The symptoms are rigors, with sweats, fever, pain in the head and back of the neck, followed by stethoscopic indications of pleurisy; vomiting is often present. Tenderness and swelling may generally be found in the course of the jugular vein. On examination after death the portion of the mastoid cells, forming the floor of the lateral sinus, is carious to a greater or less extent, and that vessel contains a disorganized clot mixed with pus.

Although when these affections of the brain or lateral sinus are once established, the surgeon is powerless to stay their course, yet many cases occur in which symptoms of the most threatening character may be entirely removed by care. In these patients either the membrana tympani has been perforated and the mucous membrane of the tympanum inflamed, for a long time, a purulent discharge from the meatus being either constant or occurring at intervals; or, without rupture of the membrana tympani, there is a chronic inflammation of the meatus attended with discharge. During a cold, or from general ill-health, or from a blow, or even without ascertainable cause, the symptoms become aggravated, perhaps the discharge suddenly ceases; pain arises in the ear, extends over the side of the head, and is greatly increased by motion; giddiness may follow, with inability to stoop; fever is sometimes, but not always present, and there may even be delirium; or slight attacks of the kind may recur at intervals and pass off. In these cases an entire abstinence from work, or any kind of excitement, must be enjoined; and, except in the mildest forms of the disease, the patient should be confined to bed. Leeches should be freely applied around and beneath the ear, and by fomentations and poultices the external discharge, if it have ceased, should be encouraged to return. The meatus may also be syringed, very gently so as to avoid giving pain, with water as warm as it can be borne. After the leeches counter-irritation should be employed; and a seton may be worn at the back of the neck until every symptom of cerebral irritation has disappeared. Purgative and alterative medicines may be administered, according to the judgment of the surgeon; but the latter demand caution. The injurious effect of mercury, when once suppurative action has commenced within the brain, is well known. If there be any puffiness or tenderness over the mastoid process, an incision down to the bone in that region should not be omitted; and any obstruction to the escape of matter should be thoroughly removed. Under these means symptoms of a very serious aspect will often entirely disappear; but great perseverance and prolonged caution are required. Frequently an incision of the membrane and washing out of the tympanum, as before described, will be found the needful remedy.

Another fatal consequence of disease of the ear is hemorrhage. This occurs from ulceration of the coats of the adjacent vessels. Sir W. Wilde relates two cases, following scarlatina, in one of which the lateral sinus was found ulcerated. One case I have seen in a man of middle age, in whom severe pain in the ear was followed by repeated attacks of bleeding from the meatus. The patient sank, apparently exhausted by loss of blood; and on examination there was found caries of the tympanic walls, causing ulceration of the coats of the carotid artery.

Malignant Disease of the Ear.

This is an affection occasionally met with, though it is not frequent. It commences in the deeply-seated parts of the organ; and a large part of the temporal bone and of the adjacent portions of the skull may be destroyed before life succumbs. The affection calls for no special remark, except that, as before observed, it is at some stages liable to be mistaken

for polypus. The only case in which real difficulty would be likely to arise in the diagnosis, might be that of a polypus causing irritation of the brain by preventing the escape of matter; and here the history, and the difference of the symptoms in the two cases, could hardly fail to give the necessary guidance.

Affections of the Labyrinth and Auditory Nerve.

These are divisible into two classes; those in which demonstrable pathological changes are or are not present. But our knowledge on the subject, and our means of diagnosis, are both as yet very imperfect. Among the morbid conditions found within the labyrinth, the most frequent are: vascularity of the walls and membranous tubes; deficiency of the labyrinthine fluid; excess of otoconia; effusions of lymph, of red serum, or of blood, the latter being chiefly found after typhus or typhoid fever. The tympanic aperture of the cochlea has been found filled with osseous deposit. The auditory nerve is sometimes, especially in old persons who have been long deaf, atrophied, and much reduced in size.

In some instances the bony portion of the internal ear becomes necrosed, and finds exit through the meatus externus without producing disease within the skull. In a patient of Mr. Shaw's, a boy who had suffered from scarlatina two years and a half before, almost the whole of the bony labyrinth was thus cast off, being removed by the forceps from the external meatus.[1] And in the case of an old man, who came under my own observation, the entire cochlea, with some of the adjacent bone, had come away.

Ménière has reported two interesting cases:—

One of a girl exposed to severe cold for several hours, by having to travel in an open carriage at night, during the catamenial period. In a few hours she became completely deaf, without pain. Death soon followed. There was found, throughout the labyrinth, "a sort of plastic, reddish lymph, which appeared to be the product of an inflammation of all the membranous surfaces which line the internal ear." In another similar case, proving fatal in two months, there existed the same plastic lymph, of yellow color, occupying the labyrinth, with a number of small gray opaque points scattered through it, resembling commencing tubercle.

Few cases precisely similar to these have been met with since, but there is a frequent and well-marked affection which seems evidently to have some relation to them. The patient, probably entirely free from any previous affection of the ear, is suddenly seized with giddiness, and in severe cases with nausea, and finds himself unable to walk steadily; at the same moment he becomes conscious of a sound in one or both ears, which may be of various kinds; often it gives him the conviction of some external source of sound. The giddiness, etc., pass off in a few days entirely, but the hearing of one or both ears remains very greatly impaired, and the tinnitus continues. Of the condition of the visible parts of the ear at the time of the attack I cannot speak, but on examination, after the lapse of weeks or years, the tympanum appears quite normal; the nerve is partially paralyzed. The pathology of the affection is not yet known, since it appears not to shorten life. My own guess is that the severer cases indicate apoplexy of the labyrinth; the slighter ones, probably, some sudden increase of fluid pressure. I have not found any remedies successful. It is natural to suppose such an attack to depend on general impairment of health, and in most cases the patient is weak or anæmic. But I have met with the symptoms in a strong young man in whom I could discover no other deviation from perfect health. With time the affection may be expected to become less severe.

Akin to this affection are certain acute affections of children, in which, after suffering from severe head symptoms, often with repeated convulsions, the child recovers, but remains totally, or almost totally, deaf. Some of these cases are probably, at the commencement, simply inflammation of the tympanum; but others, no doubt, involve the nervous centres. They will be understood when the ear is no longer thought too insignificant or too remote to receive the attention of the physician.

A form of "nervous deafness" also follows parturition, the tympanum remaining healthy; but more often the deafness that dates from a confinement includes a chronic tympanic inflammation. Deafness sometimes coexists with epilepsy, but the connection between the two affections is not clear. In one case, that of an otherwise healthy man, who had been the subject of syphilis, the hearing suddenly returned after a slight epileptic fit—apparently the only one—and has not been lost again.

Painful affections of the fifth nerve, besides their influence in inducing and maintaining disease within the tympanum, may apparently induce paralysis of the auditory nerve. The hearing may be suddenly lost after a severe neuralgia.

[1] Transactions of the Pathological Society, vol. vii., p. 335.

Connected with this, probably, is a fact I have noticed, that in "nervous deafness" the tympanum is not unfrequently partially anæsthetic.

Falls on the head paralyze the hearing, as also do loud and long-continued noises, such as those to which boiler-makers are exposed. I have met with a man who almost totally lost his hearing through being in a church belfry while the peal was rung. Rifle shooting deafens in some the right, in others the left, ear. A cannon that is suddenly fired on the Rhine steamers, to show an echo, has been assigned to me as the cause of deafness by more than one patient; as also has the sudden pressure involved in descending in a diving-bell. Quinine often produces temporary deafness, but I have seen no reason to believe this effect is permanent. An ounce taken by mistake at once produces deafness only for a time. The hearing is sometimes totally destroyed by scarlatina, evidently by some nerve affection. Mumps are peculiarly prone to induce an affection of this kind, the nature of which is yet unexplained. A sudden exposure to severe cold appears to influence the auditory nerve sometimes, as it does the facial. Tumors of the brain may have loss of hearing among their symptoms. But apart from any causes of a decisive character, a mere failure of the function of the nerve is frequently, though less frequently than has been supposed, met with among the deaf. It is easily recognized by the tests mentioned above; frequently an hereditary predisposition is present; the aspect is often peculiar, especially a certain look in the eyes; and for the most part there is aggravation of the deafness by excitement or depression of mind. Tinnitus, often constant, and of a very distressing character, is generally present.

Thus patients suffering from deafness due to conditions of the nervous system come under two classes: those in whom the affection is seated (probably) in the labyrinth, or auditory nerve; and those in whom the deafness is accompanied by general nervous debility, and is to be referred rather to the nervous centres. Among the latter are the cases of deafness arising from prolonged lactation, or the operation of other debilitating causes, such as fatigue in tropical climates, excessive exertion of body or mind, overstudy, sorrow, want of sufficient sleep. In persons predisposed to the affection, very slight causes may apparently determine its access. In one well-marked and severe case, it supervened upon the administration of a strong purgative. This form of deafness is by no means confined to adult life; if anything, it is more frequent in the young; and it may be met with among children at school, or subject otherwise to excess of study. Deafness has alternated with other affections as a result of worms.

I am of opinion that there may be a "hysterical" deafness; at least I have met with the case of a girl who suffered greatly from the confirmed intemperance of her mother, and who was liable to very complete temporary loss of hearing. It would come on rapidly, and disappear suddenly, the hearing being good in the intervals. The inspection of the ear revealed no disease.

The extreme slightness of the causes to which nervous deafness often appears to be due, early attracted my attention. I have known it brought on by a quarrel, and even assigned by a strong man to the excitement of requesting from her parents their daughter's hand. In this last case, however, it appeared that, a few years before, the patient had been stunned and partially deafened for a time by a fall down his college stairs. It is probable, surely, that the real cause of his deafness was this fall, and not the quite normal mental agitation with which its access coincided. And further observation has confirmed me in the opinion that the "nervous" form of deafness, which follows trivial causes, is very often due to shocks or diseases long previous, of which the effects have remained, and were latent or unnoticed, until the occurrence of some slight accident. And among these "latent" causes of nervous deafness I am disposed to assign a very important place to the "earache" which is so common in childhood, especially if it be *not* attended with discharge.

There is one symptom which is present in some cases of nerve deafness which appears to me of considerable interest, viz., an *inversion* of the normal effect on closing the meatus, while the tuning-fork is placed upon the vertex. Very many patients, assuming instead of observing, will say at once that its sound is diminished, but need only to have their attention aroused to recognize that it is increased. But there are some who so persistently and intelligently affirm that it is diminished, and they form so consistent a group of cases, that it is impossible to question the fact. This diminution of the sound of the tuning-fork on closure of the meatus, appears to me at present to be explicable only as an indication of an increase of the fluid pressure within the labyrinth. I have not been successful in dealing with it.

The treatment of nervous deafness should be guided by the nature of the affection. If there be reason to suspect a syphilitic taint, or if the gouty or rheumatic diathesis be well marked, and there

exist signs, however obscure, of an inflammatory or irritable condition of the labyrinth or nerve—as for example, the increase of deafness or of tinnitus by moderate stimulants, such as a single glass of wine—a corresponding antiphlogistic and specific treatment might be had recourse to. But for the most part, if the deafness be truly seated on the inner side of the tympanum, severe measures do unmitigated harm. Repeated blistering may effect a temporary improvement, at the expense of a permanent aggravation. Some reliable authorities recommend the continuous galvanic current, but my own experience and observation have not been very favorable. I should confine its use to one ear. Whenever the affection can be traced to any debilitating cause, and it is of recent access, the removal of the cause with a general tonic hygiene may be attended with a perfect cure. Mr. Toynbee had great confidence in a combination of quinine and morphia in small doses, taken perseveringly once or twice a day. Stimulating liniments around the ears, perhaps containing chloroform, if tinnitus is a prominent symptom, are at least unobjectionable; and the use of cold water and friction may in most cases be advised. I have seldom known benefit produced by strychnia. Mr. Braid, in the Association Medical Journal for September, 1855, has reported cases of "nervous deafness" benefited by hypnotism. In some cases connected with fevers, the biniodide of mercury with iodide of iron have seemed to do much good.

There is a form of nerve-deafness clearly connected with over-work; I should describe it as a kind of reflex irritation from the nerve of special sense, to the nutritive and muscular nerves of the tympanum. It is attended with more or less tinnitus, and symptoms of irregular action of the muscles of the ossicula, and there are slight appearances of congestion of the mucous membrane. But in the main the symptoms are those of impaired nerve power, and they vary decidedly with the general tone. The treatment should be very careful so far as local measures are concerned, and the prognosis, if taken in time, and rest secured, is decidedly favorable. Children born in the tropics are liable to become deaf about the age of puberty, and to baffle treatment, for some cause unknown. A form of hardness of hearing that closely simulates failure of the auditory nerve, appears to me to be dependent upon loss of power of the tympanic muscles—in short, a failure of the tympanic adjusting power. The inconvenience is not very serious, though it is annoying. The patient complains that he cannot follow general conversation, and on examination it is found that the tympanum transmits sound fairly, and that the hearing for single sounds is good, but that quick modulations of the voice cannot be followed. Galvanism might be useful in these cases.

If hearing-trumpets are had recourse to in these cases—and they are advisable when the deafness is confirmed—care should be taken that they are such as not to try the ear, by producing a loud metallic resonance. The patient's own sensations are the best guide in selecting them, and they should not be more powerful than is absolutely necessary. A very convenient form is one that passes by a spring over the head; and in the case of women it may be almost entirely concealed by the hair. Mr. Marshall's may be specially recommended.

Loss or diminution of the nervous power often coexists with other diseased conditions of the organ, and may aggravate the effect of inflammatory lesions of the tympanum, membrana tympani, or meatus. In these cases the symptoms are of a mixed character.

A true *neuralgia* of the ear exists, though rarely, except as connected with disease of the teeth. It is strictly periodic; the ear is healthy in all respects, and the hearing is not diminished. It demands nothing peculiar in its treatment.

[*Teeth and Ears.*—The irritation frequently excited in the ear by teething has not been fully appreciated. Very often it is not recognized at all, and complaints, alarming symptoms, and even death are ascribed to some obscure cause. The diagnosis of inflammation of the brain may be a correct one, but the origin of this lesion is not perceived by the medical attendant.

A tooth forcing its way through the gum, conveys irritation to the otic ganglion through the filaments of the inferior dental nerve, and the irritation thus communicated to the carotid plexus, so inhibits these vaso-motor nerves as to cause a dilatation of the bloodvessels controlled by them. As the carotid sends branches to the membrana tympani and middle ear, congestion and inflammation in these parts is the result. This inflammation in the ear of an infant is easily communicated through the tegmen tympani, or through the petro-squamosal fissure to the meninges or the substance of the brain, and the child rapidly succumbs.

Unfortunately, in many instances, the true cause of this chain of events is not recognized, the child is said to have convulsions from teething, which is true, but with a hiatus in the statement of the sequence. A mercurial treatment is too often relied upon in vain, with blisters to the head and neck. If by chance the gum is lanced over the offending tooth,

the irritation may be removed before serious results are induced. In any case, when an infant who is teething begins to fret greatly, to toss and writhe about, and to make puny efforts to touch the ear, it should be suspected at once that the ear has been brought into the circle of irritation from the diseased teeth and gums. If relief is not speedily given the membrana tympani will either rupture and permanent ear disease be established, or the aural inflammation will produce inflammation of the brain. The child will then fall into convulsions, and death will terminate its sufferings.

In all such cases of violent symptoms in teething, the true cause should be suspected at once; the gum over the offending tooth should be well lanced; the ear should be examined, and, if the drum-head is seen to bulge, it should be lanced and the puriform matter let out. This will arrest the disease, which otherwise is only too likely to spread to the brain. The reader is referred to Dr. Samuel Sexton's Prize Essay, read before the New York County Medical Society, Oct. 27, 1879, for a most complete explanation of this highly important subject.]

Tinnitus may exist as a symptom of the most various affections, from cerumen in the meatus to undigested food in the stomach; and its treatment is, in the main, the treatment of its cause. But when it seems to exist as an isolated symptom, and no cause can be clearly discovered for it, the remedy I have found best worth trying is scruple doses of hydrochlorate of ammonia three times a day. It seems sometimes to have the same power over tinnitus that it has over some forms of neuralgia. The bromide of potassium I have not found equally useful. Spirit of camphor and liq. opii, forty drops of each in an ounce of glycerine, have also given relief. Vapor of chloroform, applied through the Eustachian tube, has been recommended; but in very severe cases, as also in extremely obstinate neuralgic pain of the tympanum, I have found the injection of a few drops of a solution of atropine (gr. $\frac{1}{8}$ to ʒj) the most effectual local application.

A loud report like a pistol, occurring frequently as sleep approaches, I believe to be due to over-fatigue; especially to over-fatigue of the better ear, in cases of one-sided deafness. Some persons are troubled with cracking in the ear, keeping regular time, but intermitting; it is due, at least sometimes, to an action of the tensor palati upon the Eustachian tube; in some other cases the tensor tympani is the muscle in fault, and the malleus may be seen to move with each recurrence of the sound. Some persons have the power of voluntarily producing one or other of these movements.

Excessive sensibility to sound (or hyperacousia), and the perception of a second sound, often discordant, accompanying every tone (paracousia), are rare phenomena, except as occurring in the early stages of inflammation within the tympanum. They are, however, sometimes persistent, and occasion great annoyance. A case is quoted from Sauvage, in which a musician was compelled to give up his occupation because he continually heard a second inharmonious note with every note he played.

A buzzing sound, like the twang of a loose harp-string, sometimes accompanies particular notes. This occurs, I believe, during the early stages of catarrh. Inability to hear certain notes has been observed, and is ascribed to loss of power of certain special portions of the cochlea. Dr. Lucae relates a case of this kind in which he constructed "resonators" answering to the missing notes, and by wearing these the patient regained the lost power.

Among the causes of deafness, having its seat partly in the nervous structures of the ear, must be mentioned *hereditary syphilis*. According to Mr. Hutchinson's experience, which my own has entirely confirmed, deafness of a very extreme character is frequent among this class of persons.

The general characters of the disease as described by him are present. The deafness occurs for the most part about the time of puberty, and rapidly becomes very intense. The tuning-fork is scarcely heard upon the head. The membrana tympani is generally but slightly altered, and the Eustachian tube is pervious. Among the poor and hardly-worked, the prognosis is very unfavorable; but among those more fortunately circumstanced, a satisfactory result may often be obtained. The medicine that has seemed most useful to me is the hydrochlorate of ammonia in ʒj doses, but the ordinary mild specific treatment may be serviceable. Injection of vapor of iodine, or of the mixed solution of ammon. chlor. and hydr. perchlor. into the tympanum, have appeared to do most good.

DISEASES OF THE NOSE.

By Arthur E. Durham, Esq.

Revised by J. Solis Cohen, M.D.

I. AFFECTIONS OF THE EXTERNAL PARTS.

Acne Rosacea. Gutta Rosacea vel Rosea.

The skin of the nose is especially liable to the various morbid conditions commonly included under the term "Acne Rosacea." The appearances presented vary greatly in different cases. They depend not only upon the stage the malady may have reached, but also upon the particular form or variety which may be under observation. In most cases, however, if not in all, the earliest symptoms are due to excessive injection, followed by congestion of the superficial capillaries of the skin. Sooner or later the sebaceous follicles usually become involved to a greater or less extent. But these organs are not the parts primarily affected. Hence many authorities[1] object to the application of the generic term "acne" to the affections under consideration.

In the simplest, and perhaps most common form of acne rosacea, the skin at the spot affected is more or less intensely red, and generally has a somewhat shiny, greasy appearance. There is no obvious swelling or deformity of the part. A sense of heat is often experienced by the patient. This, however, is not constant, but comes on after food, or after exposure to changes of temperature. The tip or one side of the tip of the nose is often the only part affected. Occasionally the part looks as though it had been *frost bitten*.

In another and more severe form the greater part or whole of the countenance presents an unnatural degree of redness; and numerous dilated and congested vessels, ramifying in the skin, can be seen by the naked eye. The tint varies according to circumstances from a brightish red to a dusky purple. Sometimes the sebaceous follicles are involved, and the surface of the skin becomes more or less marbled and irregular.

These two forms of acne rosacea are much more common among women than among men. In women they are most frequent at the age of puberty, and at the climacteric period. In men they most frequently occur at the commencement of the decline of life. They do not appear to result from habits of intemperance, but are rather due to disorders of the digestive system, to exposure to the weather, and in the female to menstrual irregularities.

There is a third form, however, especially affecting, and often confined to, the nose, which is most frequently, if not invariably, met with among men who have been habitual "spirit-drinkers." It is rarely if ever seen in any one under fifty years of age. The "spirit-drinker's nose" is more or less swollen and shiny and greasy. It is of a dusky or purplish red color, and somewhat cold to the touch. On close examination the skin is seen to be traversed by numerous distended blood-vessels, but between them its appearance is comparatively natural. The sebaceous follicles are generally enlarged and inflamed; and the aspect becomes irregular and pimpled. At a later period the swelling increases, and the nose becomes protuberant. Its surface is covered with tubercles or blotches, or studded by minute pustules, or disfigured by adhering scales and crusts. The cutaneous venules are greatly distended, and sometimes varicose; and their dark purple ramifications become characteristically manifest.

Treatment.—Attention to the general health is in the first place necessary. But very diverse treatment is required in different cases. Disorders of the digestive system, and sexual irregularities, must be especially inquired into, and if possible corrected. There is usually more or less general debility. In some instances tonics and stimulants are useful from the first; in others free purgation is indicated as a preliminary measure. Any such habits or practices as may seem to have caused, or to aggravate the local capillary congestion upon which the affection primarily depends, must be avoided. Moderation in the use of alcoholic drinks must be insisted on; and in some cases total abstinence may be advantageously enjoined.

[1] See especially Erasmus Wilson, Diseases of the Skin, p. 208.

But general treatment alone rarely suffices to restore the reddened nose to its natural condition. Local remedies are requisite, and in recent cases are often speedily efficacious. In the early stages and when the affection is slight, frequent bathing during the day with water as hot as can be borne, and bathing every night and morning with a weak tepid solution of bichloride of mercury (gr. j or ij to ℥j) may be recommended. Wilson advises washing with cold water and juniper tar or carbolic acid soap twice daily: the ablution is to be followed, if much irritation is produced, by the application of benzoated zinc ointment. Subsequently an ointment of hypochloride of sulphur is to be rubbed in.[1] According to Hebra[2] (and Alibert) sulphur in the form of a soap, or an ointment, or as a solution of liver of sulphur, is the best application. The part affected is to be thoroughly washed at bedtime with soap and water. The remedy is then to be well rubbed in, and not washed off until the following morning. In some obstinate cases the chloride or the iodide of sulphur in the form of ointment may be used with advantage. It must be borne in mind that the various applications mentioned are all of them more or less stimulating and irritating, and that therefore (as pointed out by Hebra) the immediate effect of their application is apparently to do harm; and "it is only after a little time that the good which they do becomes evident."

In cases of greater severity and longer standing, in which the cutaneous vessels are much distended, and the swelling of the part affected is considerable, Hebra recommends a number of longitudinal incisions to be made into the dilated veins, especially those of which the loops are visible. After the blood has flowed for a little time, the parts are to be touched with a brush dipped in the liquor ferri perchloridi. Very little reaction follows. This method of treatment has been followed by very satisfactory results. In some instances it has been necessary to repeat the scarifications on several occasions. Scarification of the vessels without the application of the perchloride is not, as a rule, effectual.

Integumentary Hypertrophy. Lipoma Nasi.

In cases of acne rosacea of long standing and severe form, the integumentary structures of the nose sometimes become irregularly hypertrophied, and "fleshy excrescences" or outgrowths result.[1] These outgrowths vary greatly in the degree of development they attain, and the appearances they present. In some instances they are scattered, sessile, and wart-like. In others they are aggregrated and flattened, and extend more or less uniformly. In others again, they are pedunculated, and form irregular globular or lobulated masses, which give rise to great disfigurement. In extreme cases they hang down as far even as the chin, and interfere with respiration and speech. Sometimes they project upwards to such an extent as to obstruct the vision of one eye or both, so that the patient cannot see objects in front without changing the position either of his head, or of the nasal protuberance. They are generally dusky or purplish in color, and somewhat cold and greasy to the touch. They rarely occur in individuals under fifty years of age, and scarcely ever in women. They appear to be less frequently met with now than in former times.

When cut into, these growths present a brawny consistence; and in places they are occasionally almost as hard as cartilage. They consist of hypertrophied and infiltrated skin and connective tissue, with dilated venules, and enlarged sebaceous follicles. They never involve the cartilages or mucous membrane, nor do they encroach on the interior of the nostrils. They contain, as a rule, little or no fatty tissue. Hence their common appellation (lipomata nasi) is obviously inappropriate.

Treatment.—The only treatment that can be recommended is removal by the knife. In operating, the growths may either be simply cut off one by one; or an incision may be made in the median line down to the cartilage, and the skin with its outgrowths dissected off on either side. Care must be taken not to cut through the cartilages. During the operation, the surgeon or his assistant should keep a finger in the nostril to serve as a guide. The bleeding which ensues may be readily checked by pressure or by the application of styptics. There is much less danger of erysipelas and other serious results than is commonly supposed. The exposed surface usually heals favorably under cooling and soothing applications. When cicatrization is complete, it is remarkable how little disfigurement remains. In some rare instances there has been recurrence of the growth after extirpation.

[1] Wilson, op. cit., p. 211.

[2] Hebra, on Diseases of the Skin (Sydenham Soc. Translation), vol. ii., p. 334.

[1] Hebra describes these "fleshy excrescences of the nose" as characterizing "the third degree" of acne rosacea. Other authors include them under the term "acne hypertrophica." Hardy, Leçons sur les Maladies de la Peau, p. 115.

Lupus.

Lupus exedens in a large majority of cases first attacks, and most seriously affects, the skin of the nose. So also does lupus erythematosus, but in a somewhat smaller proportion of cases. Lupus non exedens, on the other hand, most frequently commences on one or other of the cheeks or lips, but in its onward progress it often invades the nose. Hence it might appear that only the first named form, and perhaps the second, demand special description in the present Essay. But all three forms of lupus appear to be associated with similar constitutional peculiarities; and they present, in their course and results, certain characteristic phenomena which are common to all of them. Moreover in some cases the distinctive features of the form under observation are not well marked; or two forms may exist at the same time in different parts. In other cases one form may seem to pass almost imperceptibly into another. For example, what is lupus non exedens on the cheek may become lupus exedens when it invades the nose. And thus even the different described forms and varieties of this affection may be regarded as only so many different modes of expression, as it were, of the same, or of a nearly similar morbid condition. It is scarcely possible, therefore, to discuss thoroughly any one form of lupus without reference to the others.

All the forms of lupus are ordinarily classed among those affections which are considered to denote the strumous or scrofulous diathesis. All occur most commonly, if not invariably, during youth or adolescence. All present the following characteristic phenomena: First, infiltration of the skin (or mucous membrane) by material of imperfect organization and low vitality; secondly, slow, insidious, and progressive destruction of the normal tissues; thirdly, absolute persistence of more or less depressed scars after cicatrization;—in other words, deficient restoration of the parts destroyed.

Notwithstanding the close relationship thus indicated as existing between them, it is nevertheless of some importance to distinguish the different typical forms of lupus one from another.

The broad distinctive features generally recognized are as follows:—

Lupus exedens and lupus non exedens in their earlier stages are papular, and become tubercular by aggregation and union of papules. So far they resemble one another, but the papular stage is less commonly observed in lupus non exedens than in lupus exedens. In their more advanced stages they differ. In lupus exedens, ulceration takes place. This ulceration is at first superficial, but subsequently eats more or less deeply into the subcutaneous tissues. In lupus non exedens, no true ulceration occurs; but atrophy, degeneration, and absorption of the dermic structures in turn ensue. Lupus erythematosus appears as a circumscribed red patch, which is scarcely perceptible, or only very slightly elevated, and neither papular nor tubercular in appearance. Atrophy and absorption subsequently take place, as in lupus non exedens, without ulceration, but the destructive process does not as a rule extend so deeply. It is stated that in some cases the papillary layer only of the corium is destroyed.

We may now proceed to discuss some of the more special points in the history and treatment of each form of lupus.

Lupus Exedens. Noli me Tangere.

This form of lupus usually commences on one or other of the alæ, the tip, or the columna of the nose. It may commence either in the skin or in the mucous membrane; or it may attack both simultaneously, in which case its progress is as a rule comparatively rapid.

Like the other forms of lupus it occurs most frequently among young people or among those who are about entering upon adult life.[1] It sometimes commences during early childhood, but very rarely, if ever, after middle age. It is somewhat more common among females than among males, and is prone to affect those who are of fair, or even rosy complexion, with thin delicate skin, auburn hair, and light gray or blue irides. It is associated, as a rule, with other indications of strumous constitutions or tendency in a more marked degree and more constantly than is certainly the case with lupus erythematosus, and perhaps also than with lupus non exedens.

On first inquiry or merely superficial examination, it may appear that the general health of the patient is good. On careful investigation, however, evidences of more or less functional derangement of the chylopoietic viscera may generally be discovered. The tongue is redder than natural, especially along the margins, and towards the tip; and the middle portion is often covered by cream-colored fur, through

[1] Out of 298 cases of Lupus Exedens which have come under my observation, or of which I have collected notes, in 173 cases, or about 58 per cent., the patients were females. The average age at the time of observation was 17 years; but in many cases the disease had commenced much earlier than when first under observation. The nose was affected in 93 per cent. of the cases.

which the red papillæ project. The breath is more or less offensive. The evacuations from the bowels are irregular and unhealthy. Other symptoms of "strumous dyspepsia" often present themselves. The processes of assimilation, nutrition, and sanguifaction are carried on feebly; and there is usually more or less general anæmia, with pallor and flabbiness of tissue.

Lupus exedens first shows itself as one or more red or brownish-red papules which increase very slowly in size, and often remain for a long period without manifesting any obvious change. After a time other papules spring up around or between those which originally appeared, and all becoming gradually blended together a tubercle is formed. The tubercle at first may be about as large as a lentil or small horse-bean; but it is liable to considerable variation in extent and prominence. Its surface may be smooth or covered with thin white scales. At a later period one or more minute yellowish specks appear. These increase in number, and become more or less distinctly pustular, and irregularly confluent. The epidermis becomes raised, and then gives way, and, with the ill-formed purulent secretion and tissue-débris accumulated beneath it, soon dries up into a thick grayish-yellow crust. On removing this crust an uneven ulcerated surface is exposed, which bleeds slightly in some places, and in others is covered by a peculiar semi-purulent viscid exudation which speedily concretes on exposure to the air. A new crust is thus formed, and beneath it the ulcerative process goes on. The crusts vary in thickness and general appearance according to the quantity and relative proportions of the materials entering into their composition. They vary also in the degree of intimacy with which they adhere to the subjacent surface. The ulcerating surface is in some places papillated or mammillated and red, in others depressed, excavated, and comparatively pale, or grayish-yellow. Its edges are somewhat jagged in outline, but bevelled, and almost or altogether on the level of the surrounding skin, which is more or less reddened, but rarely swollen or indurated to any noteworthy extent. This process goes on slowly and insidiously. Fresh papules, tubercles, and "pustules" appear at various points around the circumference of the ulcerated patch; and the ulceration gradually extends until a more or less considerable portion of the countenance is involved. The skin, with the hair follicles, sebaceous follicles, and sudoriparous ducts, and also sometimes portions of the subcutaneous areolar tissue, are liable to be destroyed in turn. But the destructive process rarely penetrates deeper, except in and about the nose and eyelids. In the nose, the cartilages and the small muscles which move them are often destroyed; and great deformity results. This, as may readily be understood, most frequently occurs in cases in which the mucous membrane is simultaneously affected. Sometimes even the nasal bones and the vomer may suffer to some extent. But the graphic descriptions given by the older writers (as well as by some modern ones) of the direful ravages of "lupus," seem to apply to the effects of rodent cancer rather than to those of the malady now under consideration. The distinction between these two affections is sufficiently clear, as will be hereafter shown; and the distinction is one which for practical reasons must be carefully made.

While the processes of destruction and ulceration thus described are extending circumferentially, it very often happens that processes of repair and healing commence centrally, and gradually spread. In such case the ulceration may become for a time more or less "serpiginous" in character. In this way, perhaps after months or years, cicatrization at length advancing more rapidly than ulceration, and the disease having as it were worn itself out, a natural cure may result. Sometimes, however, and somewhat more frequently, the destructive process seems to stop short. The surface loses its irregular papillated appearance; the excavated spots become pink; the secretion is diminished in quantity, becomes thicker and for a time more truly purulent in character; and cicatrization commences at the circumference, and gradually advances towards the centre.

The cicatrices are at first covered by a thin shining epidermis, through which the red remaining portions of the corium or subjacent tissues can be seen. After a time the epidermis increases in thickness; and the cicatrices become paler, but are traversed by slightly elevated lines or ridges radiating from a centre, and are sometimes marked here and there by small bloodvessels. Still later the cicatrices become almost white, and more or less contracted, and irregularly depressed. Their contraction gives rise to various deformities, or increases the deformities already produced by the preceding destruction of tissue. The point of the nose may be drawn down; or one or other of the alæ may be turned upwards, or the eyelids or lips may be everted. The probable stability of the cure may be inferred from the character of the cicatrix. If the new skin is soft and free from tenderness, and soon presents a nearly natural color, it may be considered sound; but if, on the other hand, it remains for any length of

time unnaturally red and indurated, or if it continues delicate and membranous in appearance, and is traversed by numerous tortuous bloodvessels, there is considerable probability of a relapse.

A well-established tendency to relapse, or to reappearance of the disease in some part before unaffected, is a noteworthy feature in the clinical history of lupus.

The interstitial changes which take place during the progress of lupus have been made the subject of careful microscopical investigation by Wedl, Auspitz, Rindfleisch, Neumann, and others.[1] It would appear that in the earlier stages the cells of the rete Malpighii multiply rapidly, and become granular and fatty; the corium becomes succulent, and is infiltrated, and more or less distended with new connective-tissue elements and rounded or oval cells with nuclei and nucleoli. The subcutaneous areolar tissue is similarly affected to a variable extent. The normal tissues are no longer healthily nourished, and consequently become atrophic. During the later stages the atrophied tissues and the new elements break down, and become transformed into a molecular detritus. This, mingled with fresh exudation, helps to make up the characteristic discharge from the ulcerating surface.

The diagnosis of lupus exedens may sometimes be difficult during the earlier stages. But when the stage of gradually advancing ulceration is reached, the disease is as a rule easily recognizable. The affections with which it is most likely to be confounded are "common strumous ulceration," syphilitic ulceration, and rodent cancer. It is of great practical importance to distinguish accurately between these several affections, because each requires different treatment.

"Common strumous ulceration" is by no means constantly preceded by distinct papules and tubercles; and it is not attended in its course by the formation of fresh tubercles around the ulcerated spot. The ulcers are generally deeper than in lupus. Their edges are thin and often undermined. Their surface is either almost or entirely destitute of granulations, or is covered by small pale, flabby granulations, which bleed readily when touched. The surrounding skin is purple or violet, red, or livid. Associated with "common strumous ulceration" there is often enlargement and sometimes suppuration of the neighboring lymphatic glands, but this very rarely occurs in lupus.

Syphilitic ulceration, when affecting the nose, generally commences in the pharynx or about the palate, then invades the mucous membrane of the nose, and so extends, as it were, from within outwards. It usually occurs as a tertiary affection, and is associated with "syphilitic cachexia," and other more or less characteristic symptoms. The history of the patient affords in many cases strong presumptive evidence as to the nature of the malady. Syphilitic ulceration, commencing on the cutaneous surface, is often preceded by tubercles. But the tubercles of syphilis are copper-colored, and are harder and generally larger and rounder than those of lupus. The ulcers of syphilis are foul and sloughy. Their edges are sharply cut, and sometimes everted. The crusts formed are greenish. When syphilitic ulceration extends serpiginously, its outline is generally horseshoe-shape—not oval or circular, as in lupus serpiginosus.

Rodent cancer is a disease of declining life. It is not associated with indications of strumous tendency, but occurs in those who are otherwise healthy. Its tubercles are hard. It ulcerates very slowly, and eats very deeply into the tissues, destroying all before it—muscles, cartilages, and bones, as well as skin and mucous membrane. It shows no disposition to heal. Its edges are firm, abrupt, and precipitous. It is often accompanied by severe pain.

Treatment.—From what has been advanced, as well as on other grounds discussed elsewhere,[1] it would appear, first, that lupus may be regarded as the local expression of a morbid constitutional tendency; secondly, that when once established "the lupus process," if uninterfered with, may go on spreading during an uncertain period, and to an indefinite extent, seeming, as it were, to propagate itself; thirdly, that sooner or later all the morbid processes come to an end, tissue destruction ceases, and healing ensues.

The natural termination of lupus which thus takes place may be considered to be due either to the disease having, so to speak, worked itself out, or to constitutional changes, from advancing age or other cause, having rendered the general condition unfavorable to the continuance of the local affection. These views regarding the natural history of lupus are strongly supported by the results of different methods of treatment. And further, they serve to indicate the double direction the treatment should take in order to effect or hasten the cure. Experience has amply shown that, as a general rule, comparatively little permanent good is to be

[1] See Wedl, Pathological Histology (Sydenham Society Translation), p. 383; Auspitz, quoted by Bazin, Dict. encyclop. des Sciences médicales, art. "Lupus;" Neumann, Lehr buch der Hautkrankheiten, 1869, p. 218.

[1] See various authors on Diseases of the Skin; especially Devergie, Bazin, Hardy, Hebra, [Duhring,] and Wilson.

expected from local remedies alone. All sorts of stimulating and soothing applications have been repeatedly tried in vain. In many cases, even after the use of powerful caustics, the characteristic ulceration has speedily recurred when the immediate effects of the escharotic have passed away. So also the most judicious constitutional treatment has been tried over and over again, and persevered in for months, or even for years, without obviously producing any good effect, unless or until proper local treatment has also been adopted. It may, and probably does, occasionally happen that the disease is prevented from becoming established by the early application of caustics, or that when the morbid process has nearly worn itself out, a cure is effected under the influence of constitutional remedies. But in the majority of cases it is better to trust to neither one nor the other line of treatment alone, but to adopt both. And if this be done judiciously, it will be found that lupus exedens is by no means the unmanageable malady it was formerly supposed to be, and that it is far from deserving its common appellation of "noli me tangere"—an appellation that by misleading may prove mischievous.

In the treatment of lupus exedens it is, in the first place, desirable to correct as far as possible all that may be wrong in the general health of the patient by improved hygiene, and by such medicines as are calculated to remove or overcome any disorders of the digestive system that may be found to exist. Good air, good food, including a liberal allowance of meat and fresh vegetables, and some wine or malt liquor, are especially indicated. Sea air occasionally appears to be hurtful rather than beneficial, and in some cases alcoholic stimulants of every kind seem to disagree; but these are probably exceptional cases, although several such have come under my observation.

Various tonics, as the mineral acids, vegetable bitters, quinine, and some of the preparations of iron, especially the syrup of the iodide or the syrup of the phosphate, may be advantageously administered, and varied from time to time—due regard being always paid to the condition of the digestive organs, and to the action of the bowels. But the medicaments which are especially useful, are cod-liver oil, and the liquor arsenicalis, or Donovan's solution. Cod-liver oil should always be administered in such doses as the stomach will bear. Its influence for good in the large majority of cases is marked and indisputable. In most cases also arsenic appears to be a very valuable remedy. Mr. Hunt, to whom is due the credit of having especially urged, if not of having first suggested, its administration in this malady, considers it "absolutely a specific." He seems inclined to rely upon it almost exclusively.[1] He recommends it to be given in the largest doses, ascertained by careful trial, that the patient can bear continuously without injury. In some cases very large doses are tolerated.[2] The results of general experience testify to the beneficial effects of arsenic, but seem scarcely to confirm all that Mr. Hunt has said in its favor. Indeed, it is worthy of note that he refers to the possible necessity of continuing the use of the drug, "month after month and year after year," and even "for half a lifetime." Any "specific" influence it may possess, therefore, may be at best very slow in becoming manifest, and can scarcely be considered worth waiting for, when more speedily effective treatment is at command.

Due regard, then, being given to the general health, and such medicaments being administered as are likely to modify the morbid constitutional tendency, it is, in the second place, of the greatest importance to arrest locally the spread of the disease. This can be effected most speedily and most certainly by the absolute destruction of those parts and tissues in which the "lupus process" is going on. It matters comparatively little what method is adopted, or what particular escharotic is used, provided always that the application is thorough and efficient. It is worse than useless simply to irritate the surface of the sore; and, on the other hand, it is obviously undesirable to penetrate further than needful into the healthy tissues. That method may claim to be the best, which, on experience, is found to be most completely under control during application, and which causes least enduring pain afterwards to the patient. Judged on these grounds, the actual cautery, strong nitric acid followed by nitrate of silver, and chloride of zinc in the stick may be especially recommended. Their destructive action is certain, speedy, and readily limited and controlled in accordance with the judgment of the surgeon. Chloroform may be administered at the time of the application; and the pain subsequently experienced, as a rule, is neither very severe nor lasting. On the other hand, the pastes of chloride of zinc and flour,

[1] See British Medical Journal, 1862, vol. i., p. 8; also, On the Treatment of Lupus, by J. L. Milton. (Hardwicke.) London, 1866.

[2] See a remarkable case detailed by Dr. Andrew, in which the patient took half drachm doses of the liq. arsenicalis three times daily for a considerable period. British Medical Journal, Sept. 8, 1866.

nitric acid and sulphur, acid nitrate of mercury, arsenious acid and calomel, etc.,[1] although effective, are open to the objection that, acting slowly, they often subject the patient to hours of agony. Moreover, during their application the surgeon has no opportunity of limiting or controlling their action, nor of judging how far their destructive influence may have penetrated.

The actual cautery may be used in the form of the red- or white-hot iron, the galvano-caustic wire or pencil of Middeldorpf, or the gas cautery of Bruce. The last named is a very convenient and efficient instrument for use in cases in which the ulcers are small and superficial. The hot iron and the galvano-caustic pencil are more applicable if the ulcers are deep, or if it should be necessary to destroy much tissue.

Nitric acid may be applied by means of a glass rod, a spun-glass brush, or, best of all, a piece of rattan cane frayed out at one end, and cut to convenient size. The acid must be thoroughly applied along the ulcerating edges, and well pressed into the surface of the sore, and into all the irregularities and tiny excavations. After a few minutes the whole surface should be wiped dry and comparatively clean, and then a fresh application of the acid should be made. This process should be repeated until it is clear that all the lupus-affected tissues must have been reached by the caustic. It is then a good plan to rub a stick of nitrate of silver all over the surface, and well into the cauterized tissues. The silver salt assists in forming a good protective scab, and certainly seems to deaden and diminish the pain produced by the nitric acid.

The solid chloride of zinc in stick is especially recommended by Mr. Hutchinson. It must be thoroughly rubbed along the edges and well pressed into the surface of the ulcer. It is useless simply to touch or wipe over the parts affected: the caustic must be made to penetrate.

In all cases, before any escharotic is applied, it is necessary to clear away all crusts and scabs from the surface and edges of the ulcer. They may be softened by bathing with warm water, or by a short application of an emollient poultice, and may then be picked off. If the ulcerated surface and the surrounding skin appear much inflamed, it is better to attend to the general health, and to apply soothing ointments and lotions for a time before proceeding to the use of escharotics. Poultices and water-dressings as a rule are not suitable. In applying the escharotic, care should be taken to follow accurately every extension of the disease on the mucous membrane and into the cavity of the nose, as well as on the cutaneous surface. The escharotic must be applied to every portion of the ulcerating surface, especially to the edges along which extension of the disease is going on; and some portion of the surrounding apparently healthy skin should also be destroyed. The healing edges and the cicatrized portions of the surface need not be touched.

If the patient is under chloroform [or ether] as recommended, all that seems necessary may be done at one operation. But if the disease is extensive, and chloroform is objected to, different parts may be attacked at different times, one part being destroyed after another.

After the application of the escharotic, the surface should be carefully covered from the air by a little scraped dry lint, and a light pad of cotton-wool. This dressing may be kept on until the scab or slough separates, which usually happens in the course of four or five days. Benzoated zinc or lead ointment may then be applied, or such other dressing as may be indicated. If the escharotic has been thoroughly applied, healing soon commences, and as a rule goes on satisfactorily, provided that the general health is good, and that proper constitutional treatment is carried out. It sometimes happens that repeated applications of the escharotic may be necessary; and this is almost sure to be the case if the former applications have been too superficial, or if the escharotic employed has been too feeble in action. Some surgeons indeed prefer the repeated application of weak caustics to a single application of a strong one. Thus Hebra recommends the application of solid nitrate of silver once or twice a week. Such treatment has proved efficacious in very many cases. Hardy[1] speaks highly of the efficacy of an ointment composed of equal parts of biniodide of mercury and lard. The ointment of the red oxide of mercury, or that of the ammonio-chloride, or the ointments of lead, zinc, and nitrate of mercury mixed in equal proportions, may also be recommended in cases in which escharotics appear unnecessary, or in

[1] The following formulæ may be quoted: Chloride of zinc, 1 part; flour, gypsum, or compound tragacanth powder, 3 or 4 parts; water, q. s.; mix. Chloride of zinc, ℥iv; chloride of antimony, ℥ij; starch, ℥j; glycerine, q. s.; mix (Startin). Vienna paste: Potassa fusa and unslaked lime, equal parts; spirits of wine, q. s.; mix. Arsenious acid, 1 part; calomel, 99 parts (Dupuytren). Calomel, ℥ijss; bisulphide of mercury, ℈ij; arsenious acid, ℥j; mix (Startin).

[1] Leçons sur la Scrofule et les Scrofulides, p. 89. Paris, 1864.

which it is deemed desirable to defer their application. These ointments are often very useful also after partial or incomplete cauterization.

It must be borne in mind that although lupus is not of syphilitic origin, yet it may and sometimes does occur in those who are the subjects of syphilis. In such cases the appearances presented partake of the character of syphilitic ulceration, and the treatment must be modified accordingly. If the syphilitic taint is hereditary, mercurials prove useful. The iodide, mercury and chalk, or the bichloride in small doses may be given. If the patient is the subject of acquired syphilis, and especially if mercurials have been previously administered, iodide of potassium in full doses (twenty to thirty grains) three times a day, and iodide of iron are especially indicated. In such cases it is well to defer the use of escharotics, and to apply black lotion or one of the weaker mercurial ointments.

Lupus Non Exedens.

Lupus non exedens is slower in its progress, and less destructive than lupus exedens. It commences, according to the excellent description of Mr. Wilson,[1] "as a small tubercle of reddish-yellow or pale amber color, and has the appearance of a drop of jelly effused beneath the cuticle. . . . There is no inflammation, no redness around the tubercle, and a few minute vessels may be seen struggling through it, or over its surface." The tubercle goes on extending, and is joined by others; but the reddish-yellow tint and the somewhat "gelatinized" appearance are preserved. By and by absorption commences; the papillary layers, and more or less of the deeper parts of the corium, become removed; and a permanent cicatrix remains. No ulceration takes place. A certain amount of pricking or itching is usually experienced, but as a rule very little pain, or none at all. Sometimes the disease spreads over the greater part of the face, and considerable deformity results.

Treatment.—The treatment generally should be similar to that recommended in lupus exedens. But it is not necessary to cauterize the parts affected nearly so deeply nor so extensively as in the more severe form of the disease. Caustic potash in solution appears to be especially applicable. Tubercle after tubercle may be destroyed at different times without occasioning much suffering to the patient. Among the constitutional remedies, iodide of iron and iodide of ammonium are found to be more obviously beneficial than in lupus exedens, but arsenic does not appear to be so efficacious.[1] Cod-liver oil should always be administered in such doses as can be tolerated.

Lupus Erythematosus.

This form of lupus usually appears on the nose; but other parts are sometimes attacked at the same time or subsequently. It is a comparatively rare affection. It differs from the other forms of lupus not only in its non-tubercular character, but also in the fact that it commonly occurs in individuals who are otherwise healthy, and who manifest no indications of strumous constitution or tendency. Its general features have been already described (see page 218).

The dull or purplish-red patches, with which it commences, at a later period become depressed, and covered by scales or thin crusts composed of epidermis and dried sebaceous secretion. Still later the scales and crusts separate, and the skin beneath is found to be attenuated and to present a scar-like appearance.

According to Neumann, in lupus erythematosus the morbid process commences in and about the walls of the sebaceous follicles, which become condensed by accumulation of cells and connective tissue. The follicles lose their acinous structure, become converted into globular bodies with granular contents, but finally disappear. During the progress of the malady the other cutaneous structures suffer to a greater or less extent, and the microscopical appearances more or less resemble those met with in the other forms of lupus.[2]

Treatment.—In a large proportion of cases local treatment alone is requisite. The patches should be carefully destroyed by the application of strong solution of potash or some similar agent; or the gas cautery of Bruce or the galvano-caustic wire may be used. It is better to proceed gradually, and to repeat the application as often as may seem desirable, rather than to run the risk of destroying the tissues to an unnecessary depth and extent.

Cancerous Affections of the Skin, etc.

Rodent cancer.—This formidable malady most frequently commences near the eyelids, or about the margin of the upper lip; but sooner or later, if unchecked, it usually invades and destroys the nose,

[1] Op. cit., p. 422.

[1] Hunt, op. cit. [2] Op. cit., p. 230.

and gives rise to the most hideous deformity. It occurs in persons who are otherwise healthy and free from all constitutional taint, but very rarely in those who are under fifty years of age.[1]

It first appears as a hard tubercle, the induration of which is characteristic. The tubercle is almost always solitary at first, but at a later period other tubercles occasionally, though very rarely, appear and join the original one. The tubercle slowly but steadily increases in size, and involves the surrounding tissues. By and by a superficial fissure or excoriation appears, which for a time may be concealed by a scab. But later the fissure or excoriation becomes a deeply-eating ulcer; and the central portions of the growth and the tissues involved by it are destroyed. The process continues. The surrounding tissues are invaded by the solid growth or deposit; they become more or less indurated; and are then in turn regularly eaten away. "The growth of the solid disease is not limited to the integuments around the ulcerated cavity: it advances in depth as well as in superficial area, involving all the structures it encounters. It infiltrates the glandular textures and the bony, it spreads by the mucous and fibrous tissues, and after perforating the skull, it will still grow into the very substance of the brain. In the succeeding ulceration these structures are likewise removed, and the excavation becomes deep as well as wide."[2]

In the earlier stages there is comparatively little pain, but as the destructive process advances into the deeper parts, and especially when the eyelids are attacked, the patient's sufferings are often very severe. The lymphatic glands are rarely affected.

This malady has been described under the names of "rodent ulcer," "cancroid," "Jacob's ulcer of the eyelids," etc. etc.

Its alliance to cancer is indicated by its clinical history, rather than by its microscopical structure. Its onward progress is certain, though very slow. It never undergoes spontaneous cure: unremoved by surgical aid, it lasts until death.

Treatment.—Constitutional treatment is altogether useless. Complete excision, followed if necessary by cauterization of the exposed surfaces, or thorough destruction by powerful escharotics, is the only treatment likely to be followed by successful results. Experience shows that by such treatment much good may be done. In many cases a cure has been effected which has remained permanent for years; and in others the ravages of the disease have been checked, and the sufferings of the patient greatly diminished. If the nature of the malady is recognized early, and all the parts infected are at once absolutely removed, the patient may be saved from the most serious disfigurement and the direst suffering. And even in cases in which the disease has made extensive progress, the surgeon should not hesitate to attempt its removal. The results obtained in some such cases have been decidedly encouraging.[1] In cases in which the disease has not advanced far, and in which the whole can be satisfactorily excised, the space left may be at once covered in by a portion of transplanted integument. But in cases in which the greater part or whole of the nose is destroyed, and the cavity after excision is very wide and deep, it is better to wait until cicatrization is complete, and subsequently to perform if practicable some reparative operation. If the chasm is too extensive to be covered in by operation, or if the health and powers of the patient cannot be relied on, a mask with an artificial nose, etc., may be worn.

[1] In his excellent monograph On Rodent Cancer, recently published (Longmans, 1867), Mr. C. H. Moore mentions a case in which the growth appeared at the age of thirty-three. Mr. Hutchinson met with another in which the patient was only a year or two older.

[2] C. H. Moore, op. cit., p. 9. [See also J. Collins Warren, The Anatomy and Development of Rodent Ulcer. Boston, 1872.]

Epithelioma.

This form of cancer occasionally, though very rarely, attacks the nose. It generally commences as a small "wart;" this sooner or later becomes excoriated, and covered by a scab; after a time ulceration commences. In these earlier stages epithelioma closely resembles rodent cancer, and is with difficulty distinguished from it. But epithelioma usually commences just at the junction of the skin with the mucous membrane, or even in the mucous membrane. Rodent cancer as a rule appears in the skin at an appreciable distance from the mucous membrane. In their more advanced stages the distinctions between these two allied affections become more obvious. In both there is slowly progressive infiltration of the surrounding structures with new material, and destructive ulceration extending centrifugally. But "there is much more solid substance in the epithelioma, and the gaps which it makes by destroying the normal parts, though equally great, are less openly cavernous than in the rodent cancer."[2] The outline of epi-

[1] See cases by C. H. Moore, op. cit.; Hutchinson, Medical Times and Gazette, "On Rodent Ulcer;" also London Hospital Reports, vol. ii., p. 136.

[2] C. H. Moore, op. cit., p. 24.

thelioma is less irregularly indented, and the margins are less uniform in thickness than in rodent cancer. In epithelioma too the margins are often everted, and the surface is uneven and irregularly papillated, and sometimes covered with a cream-like juice. In epithelioma the lymphatic glands are very liable to become affected sooner or later. In rodent cancer, as already stated, this is not the case. The generally recognized microscopical characters of epithelioma (see Vol. I., pp. 288, 325) are almost or altogether wanting in rodent cancer.

Treatment.—Epithelioma of the nose may be excised, or destroyed by escharotics.

Mr. Ure refers to a well-marked case in which he effected a cure by means of an arsenical paste. He mentions also another case in which an oval epitheliomatous sore as large as a florin was treated first by excision, next by the application of chloride of zinc, then by the application of arsenious acid, and finally healed under the influence of an ointment composed of equal parts of finely-pulverized sulphate of zinc and cerate. The cicatrix was perfect a year afterwards.[1]

A remarkable case is mentioned by Mr. Moore in the first volume of this work (p. 289), in which an epitheliomatous growth commenced on the nose, and "slowly spread over the centre of the face until it reached the size of half a swan's egg." "The entire surface of the growth was made up of pedunculated rounded tumors no larger than peas, and covered with thin integument." A very similar case recently came under my care in Guy's Hospital. I removed the growth as completely as possible with the knife, and then cauterized the surface with the hot iron. Cicatrization took place. But four months afterwards the growth returned, and a second attempt to remove it was followed by an attack of erysipelas which proved fatal.

Scirrhus and encephaloma sometimes, though very rarely, appear upon the cutaneous aspect of the nose; they more frequently invade it from within. These forms of cancer demand no special description here. They should be removed if practicable as soon as recognized; and it is well to cauterize the surface left bare by the knife.

Deformities and Deficiencies.

The nose is liable to various deformities and deficiencies. Some of them are congenital; others result from accident or disease. Some are more or less perfectly remediable by operation; others are best concealed by masks or artificial noses, which are nowadays made and adapted with great skill.

[1] See the first English edition of this work.

Entire absence of the nose as a congenital affection is extremely rare, but some instances are on record.

In the case of a female infant under the care of M. Maisonneuve,[1] the nose was represented by a plane surface merely pierced by two small holes. An operation was performed by which a columella was made from the lower lip. It is difficult, however, to "see how this could have improved the child's appearance." (Holmes.)

When the nose has been entirely destroyed by disease, the chasm may be to some extent covered in by operation. But it would appear to be useless to attempt to form a new nose, if the natural and necessary framework of cartilage and bone is altogether lost. Nothing short of an osteoplastic operation would seem likely to be permanently successful. But the practical objections to such an operation in this part are sufficiently obvious; and so far as I have been able to learn, the results of the attempts hitherto made have not been encouraging.

In cases, however, in which some portion only of the nose is wanting, whether as a congenital deficiency or as the result of accident or disease, a rhinoplastic operation may be undertaken, and often with fair prospect of success. In very many instances the most satisfactory results have been achieved (see Plastic Surgery).

Occlusion and contraction of the nostrils.—These deformities of the nose are sometimes congenital, but much more rarely so than corresponding conditions of the ear, the anus, or the vagina. In some instances the nostrils are more or less completely closed by membrane,[2] in others by firm fibrous tissue, or by a simple continuity of integument. In other cases, again, one ala or both may be adherent to the septum, or even to the upper lip. All these deformities interfere with respiration, and prevent the infant from sucking uninterruptedly. The earlier, therefore, they are remedied by operation the better. In most instances a simple incision of sufficient extent carefully made through the obstructing membrane is all that is requisite. The opening must be kept patent by strips of lint or a short elastic canula, until the cut surfaces are completely skinned over. Sometimes it may be desirable to excise a portion of the obstructing tissue. In cases in which there is no indication of the opening of

[1] Bulletin de Thérapeutique, 1855, vol. xlix., p. 559; quoted by Holmes, On the Surgical Treatment of Children's Diseases, 2d ed., p. 128.

[2] Richerand, Nosographie chirurgicale, 4th edit., tome ii., p. 150.

the nostril, the adherent parts must be gradually and cautiously divided until the nasal fossa is reached. If free respiration is not materially interfered with, or if one nostril only is obstructed, the operation may be deferred for a time.

In a case under the care of Mr. T. Smith, in the Hospital for Sick Children, the right nostril had been closed from birth. The corresponding ala was flat and unsightly. The child suffered from snuffling and snoring. The adherent surfaces were divided by the knife, and the opening made was maintained during a period of three weeks by means of a portion of gum catheter. A good result was obtained.[1]

Constriction and even complete occlusion of the nostrils may occur at any period of life as the result of accident or disease. A deep burn, a wound with loss of substance, or ulceration, followed by adhesions, or by contraction of cicatrix, may give rise to such a condition. The attendant symptoms are a variable degree of embarrassment of respiration and speech; a troublesome sense of whizzing in the nose; a change in the tone of voice, which becomes more or less "nasal" in character; and, in certain states of the weather, an uncomfortable dryness of the mucous membrane of the mouth. If the patient suffers serious inconvenience, an attempt should be made to dilate any small opening that may remain by the passage of bougies, or by the introduction of sponge or laminaria tents. If such means fail, incisions should be made in the direction and to the extent indicated by the particular features of the case under treatment. Mechanical dilatation must be subsequently kept up during a considerable period to prevent the contraction which otherwise is almost certain to recur.

Clefts of the nose and fissures extending from the nostril into the cheek or towards the orbit, are occasionally met with. As a rule, they may be successfully treated by plastic operations.

Deviations of the nose.—In some cases the nose inclines towards one side or the other. Such deviation usually depends upon a corresponding curvature of the cartilaginous septum. It is often associated with hypertrophy of the anterior extremity of the septum, and of the tip of the nose generally. In consequence of the deviation of the septum, one nostril becomes more or less constricted, and may even be almost completely occluded. Respiration is principally or entirely carried on through the other nostril, and the voice is liable to be affected. This deformity is sometimes the effect of injury, but in many cases its origin cannot be explained. Little can be done in the way of remedy. The attempts hitherto made to straighten the deformed nose by means of mechanical contrivances do not appear to have been very successful. Nor have good results generally followed the removal by the knife of portions of the cartilaginous septum. Such a proceeding, however, is recommended by some surgeons.[1]

II. AFFECTIONS OF THE INTERNAL PARTS.

The cavities of the nose may be inspected to some extent either through the nostrils, or through the naso-pharyngeal openings by means of a small mirror introduced into the pharynx.[2] They may likewise be explored to some extent by the finger, or by a probe, passed either through the nostrils or through the mouth, and round the posterior border of the soft palate. But in the normal condition of parts, certain considerable portions of these cavities can neither be brought into view, nor reached by the finger or probe. Hence an absolute and precise diagnosis is often difficult, and sometimes, in the present state of our knowledge, and with our present appliances, altogether impossible.

Rhinoscopy.

Anterior rhinoscopy, or inspection through the nostrils.—In order to inspect the nasal cavities from the front, the nostrils must be dilated, and a good light must be thrown in, either directly, or by reflection from the mirror hereafter described.[3] The latter method is generally preferable for minute and thorough examination, because by it the light may be concentrated and directed at will, upon different parts in succession, and no obscuration is caused by the head of the observer, as is apt to occur when direct illumination is employed. For the dilatation of the nostrils no instrument is more generally useful than the ordinary bivalve nasal speculum (Fig. 293), or some slight modification

[1] Medical Times and Gazette, March 28, 1863.

[1] Gross, System of Surgery, vol. ii., p. 368. Philadelphia, 1872.

[2] To Czermak especially, and after him to Semeleder, we are indebted for having first completely demonstrated the practicability and value of posterior rhinoscopy.

[3] For methods of illumination, etc., see "Posterior Rhinoscopy," p. 228. and "Laryngoscopy" in Diseases of the Larynx.

of it. Mr. Hilton's modification[1] is probably the best. He recommends that the blades should be slightly curved, and somewhat longer and broader at the extremities, than they are in the ordinary instruments. The blades are introduced into the nostril to be examined, in the closed position in which they are kept by the spring between the handles. By compressing the handles the blades are

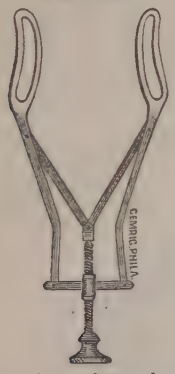
Fig. 293.

Ordinary bivalve nasal speculum.

separated, and dilate the nostril. Their brightly polished inner surfaces help to throw the light into the cavity. The blades should not be introduced beyond the catilaginous part of the nostril.

[Self-retaining specula are often requisite when intranasal manipulations are to be performed. Fenestrated specula, which are light and easily retained, are to be preferred. Of these the best is the bivalve speculum of Fränkel (Fig. 294), or the trivalve of Goodwillie.

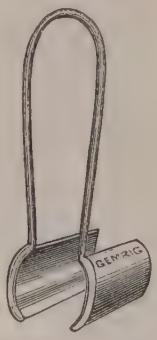
Fig. 294.



Fränkel's nasal speculum.]

Dr. Thudichum's speculum consists of two blades or valves "held together by a spring." "When compressed the valves form a canal of oval bore, about ¾-inch in length. The valve which expands the ala is from ¼-inch to ⅜-inch longer than the valve which is placed against the septum." "Each nostril requires its own speculum." [Both nostrils may be dilated at once with all these bivalve speculæ by placing one blade in each passage. This method avoids unpleasant pressure against the septum nasi.] The valves are closely compressed and introduced into the nostril. When the compressing force is withdrawn the valves are separated, and the nostril is dilated by the spring, which also serves as a handle. This speculum has obvious and indisputable merits of its own. But it often occasions pain unless it accurately fits the nostril; and the extent to which the nostril is stretched is not so easily and completely controlled as when the expanding power is in the hand of the surgeon. Such, at any rate, is the result of my experience hitherto. [It can be perfectly controlled by the disengaged hand of the surgeon in mere examinations; and by

Fig. 295.



Thudichum's speculum.

the use of a set-screw, as arranged by Dr. Schell, of Philadelphia, for purposes both of examination and operation.]

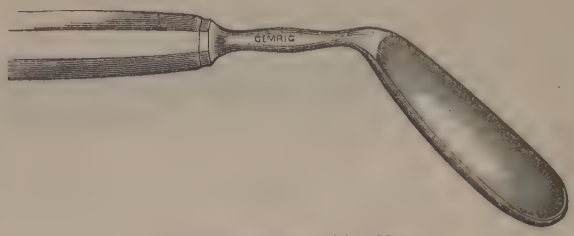
The speculum of Dr. Metz, of Aix-la-Chapelle, consists of two distinct portions. One of them is held in the right, and the other in the left hand. They may be used together or separately. It is easy to understand how by means of them the nostril may be dilated, and light reflected into the cavity. To prevent dimming of the polished surfaces by de-

[1] Made by Milliken, Southwark Street.

position of moisture, this as well as the other specula should be slightly warmed before introduction into the nostril.

In some cases, as suggested by Czermak,[1] a small oval mirror mounted at an angle upon a long slender stem, may be

Fig. 296.



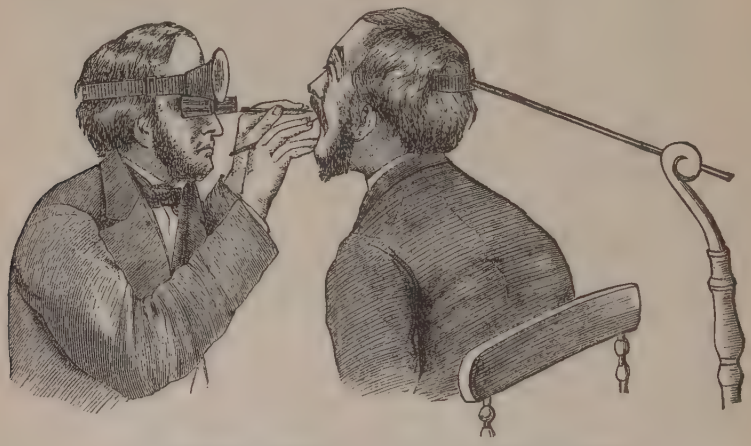
The nasal speculum of Dr. Metz.

used with great advantage. When such a mirror is introduced to a greater or less depth through the nostril, and properly illuminated, there may be seen reflected in it various parts which could not otherwise be brought into view.

Posterior Rhinoscopy. Choanoscopy. Inspection of the Nasal Cavities from Behind.

In order to inspect the nasal cavities from behind, a brilliant light is especially necessary. The instruments required are similar to those used in the examination of the larynx, with the [occasional] addition of a long narrow spatula turned up at the end, or a blunt flat hook, with which the ulva and soft palate may be supported and drawn forwards. [These latter appliances are rarely requisite, and often create so much difficulty when used that they impede the examination rather than facilitate it.] The rhinoscopic mirror, however, is smaller than any ordinarily used in laryngoscopy, and its stem should be a little longer, and bent somewhat downwards near its junction with the handle. This bend enables the ope-

Fig. 297.



The general arrangements for posterior rhinoscopy by sunlight.

rator to keep his hand in such position as not to obstruct the light. Sometimes the stem may be advantageously bent into a double curve, somewhat like the letter *f* reversed.

In making the inspection the same general arrangements are necessary as in laryngoscopy (see Fig. 297). [The head rest introduced into the figure is superfluous.] The patient is seated with his back to the light, his head is thrown well back, and his mouth opened as wide as possible, and in such manner as to display the pharyngeal cavity to the fullest practicable extent. The surgeon, seated opposite, by means of the spatula, held in his left hand, raises and draws forward the uvula

[1] Czermak, On the Laryngoscope (Sydenham Soc. Translation), p. 33.

and soft palate of the patient, and directs the light reflected from the frontal mirror into his pharynx. The speculum, held by the right hand of the surgeon, is slightly warmed, and introduced with its face looking upwards and forwards. It must be carried well into the upper and back part of the pharynx. The light is then made to shine upon it, by some slight movement, if needful, of the head of the surgeon or of the reflector. When all this is successfully accomplished, some portion or other of the walls (or contents) of the naso-pharyngeal or nasal cavities may be distinctly seen imaged in the speculum. By varying the position and direction of the speculum other parts may be in turn brought into view. Under the *most* favorable circumstances, the two superior meatuses may be inspected more or less completely, and considerable portions of the mucous membrane covering all three turbinated bones may be seen; the septum may be examined throughout a great part of its extent; but the view obtained is necessarily very oblique; some portions of the posterior surface of the velum palati may also be seen; lastly, if the mirror is turned towards one side, the lateral wall of the naso-pharyngeal cavity, and the orifice of the Eustachian tube may be brought into view. But the difficulties of posterior rhinoscopy are great, and it is rarely that the cavities may be inspected to the extent indicated; although this is theoretically possible in most cases, and has been actually accomplished in many. Nevertheless, persevering attempts should always be made in doubtful cases. Experience has amply proved that this method of examination, even when incompletely carried out, may afford most valuable aid not only in the diagnosis, but also in the treatment of various affections of the nasal cavities. To insure success, considerable practice on the part of the surgeon, and oftentimes great patience and self-control on the part of the patient, are requisite.

[The use of a tongue-depressor will much facilitate the inspection. If an uvula-elevator or palate-retractor is employed, the tongue-depressor must be consigned to the patient. The use of the depressor will often supersede the necessity for the retractor. If a fixed source of illumination is used, instead of the head-reflector, the rhinoscopic mirror can be much more easily manipulated, as the light can be directed at once upon the proper spot, and the mirror be moved about in the steady field of illumination.]

The principal difficulties arise in the first place from peculiarities in the anatomical conformation and proportions of parts. Thus the opening of the mouth may be small; or the tongue may be disproportionately large; or the posterior nares may be narrow; or the free border of the velum palati may be naturally so near to the posterior wall of the pharynx as to leave little or no available space between them. This last is a frequent source of great difficulty. Such difficulties cannot be removed, though by patience they may be to a certain extent circumvented. Secondly, there are other difficulties of physiological origin. Thus the tongue may be difficult to manage; or the soft palate may be extremely sensitive; or the natural tendency of the velum to become raised, tightly stretched, and closely approximated to the posterior wall of the pharynx, when respiration is carried on through the mouth, may come into play. All such difficulties may generally be overcome by perseverance and practice. The patient may himself depress his tongue by means of a rectangular spatula, or he may learn to keep it well down in the floor of the mouth. The soft palate, though highly sensitive at first, soon becomes accustomed to the steady touch and support of the flat hook, and in some cases may be voluntarily kept in such position as to render the use of the hook unnecessary. It is not improbable, as suggested by Czermak,[1] that some simple means may be discovered by which the natural sensitiveness of the soft palate may be temporarily diminished. The administration of bromide of potassium, recommended by Gosselin[2] as a preliminary to the operation of staphyloraphy, appears to me from my own experience worthy of more extensive trial than it has hitherto had, although it has not proved so efficacious as was expected. I have tried the chloral-hydrate in some cases, but not as yet in a sufficient number to enable me to express any decided opinion as to its merits. [Repeated contact of a foreign body, practised several times a day, is much more efficient than any medicinal agency. The local contact of crushed ice in a bag or other contrivance, kept up more or less constantly for from ten to thirty minutes before the examination, will often obtund a hypersensitive palate. The inhalation of a few whiffs of chloroform exercises a similar influence in some cases.] The elevation and tension of the soft palate, and the approximation of the velum to the posterior wall of the pharynx, to which allusion has been made as frequent sources of difficulty, occur naturally when respiration is carried on through the widely-opened mouth. But it is quite possible to breathe almost entirely through the nose, even when the mouth is open. When this is done the parts become at

[1] Op. cit., p. 76.
[2] Gazette médicale, avril 14, 1860, p. 223.

once relaxed, the velum falls, and the associated difficulty is at an end. I have found it the best plan to direct the patient to breathe through the nose as though snoring [but without making the snore, keeping just short of it, as it were].

The method of posterior rhinoscopy thus described is, I believe, the best yet devised for purposes of examination alone. The speculum and the hook which supports the velum may be moved as occasion may require independently one of the other. But in cases in which it is desired to direct the application of remedies by sight, this method has the obvious disadvantage of occupying both hands of the surgeon. Various instruments have been devised in which speculum and palate hook are so connected that they can be held and manipulated by one hand, the other being left free to operate. The best of such instruments yet contrived is, I believe, that of M. Duplay.

Nasal Calculi. Rhinoliths.

Calculous concretions are sometimes formed in the nasal cavities. Instances are rare, but a considerable number have been placed on record.

Bartholin relates the case of a young Danish female, who, after suffering for a long time from headache, passed from her nose several calculi, which in size and shape resembled date-stones. Clauder witnessed the case of a woman, sixty years of age, who expelled from her nose a very hard rounded concretion, as large as a hazel-nut. Khern noticed several pisiform calculi which had escaped from the nostrils of a young person suffering from violent headache.[1] Such and such like cases must be taken for what they may be worth. Many others, which are well authenticated, are quoted or referred to by Demarquay in his elaborate memoir on the subject.[2]

These concretions are for the most part met with in the inferior meatus of the nose. They may originate in the frontal or maxillary sinuses, and from thence pass into the nostrils. They vary in size, and increase by the deposition of successive layers. They may even attain such dimensions as to block up the nostrils, and to cause deviation or partial destruction of the septum. They are uneven on the surface, and may be black, gray, or whitish in color. In many instances they are formed round extraneous bodies, which thus constitute their nuclei. The nucleus may be a bead, a cherry-stone, an incisor tooth, a small detached portion of bone or tooth, or some other body. Often, however, no definite nucleus can be discovered; and in such cases the cause and starting point of the calculous formation remains obscure. Chronic inflammation of the mucous membrane or of the lacrymal gland may possibly give rise to alterations in the secretions, leading to depositions of calculous matter. Crust-like lumps of dry hard secretion are often formed in cases of ozæna, etc., and if any of these should be retained in the recesses of the nasal cavities it is easy to understand how they may form nuclei upon which successive deposits may be made. Such deposition may also be favored by certain abnormal anatomical conditions; as for example contraction of the nostril, or narrowing of the lower meatus to such an extent as to hinder the due expulsion of the secretions. Graefe considers that the gouty dyscrasia favors the production of nasal calculi. On the whole it would appear that the most frequent cause is the retention of some foreign body in some part or other of the nasal cavity.

The calculi themselves (according to the analyses of Bouchardat) consist of the phosphates and carbonates of lime and magnesia, chloride of sodium, and mucus or some other animal matter.

The ordinary symptoms are dryness of the affected nostril, accompanied by a sense of weight and fulness; frequently more or less obstruction of respiration; pain of an intermittent neuralgic character, referred to the nose or forehead; and sometimes inflammation, and swelling of the adjacent parts, with copious discharge of mucus and pus from the nares. The sense of smell may be impaired or abolished. The eye may suffer sympathetically, and may be suffused or bathed with tears; or there may be epiphora from obstruction of the nasal duct.

In most cases the calculus may be detected on careful exploration of the cavity by means of [the little finger or] a probe; or it may be seen on [anterior or posterior] rhinoscopic inspection. The sensation communicated through the probe, and the dull dead sound sometimes emitted, when the calculus is struck, may be considered diagnostic. But should the calculus be inaccessible to touch as well as to sight, the symptoms manifested may mislead the surgeon. Thus, the presence of a polypus may be suspected on account of the obstruction to respiration that may arise; or some primary affection of the bones may be supposed to exist, on account of the deformity of the nose which sometimes occurs, and the accompanying suppuration; or in consequence of the fetid and disgusting odor frequently exhaled, the surgeon may be disposed to put the case down as one of "idiopathic" ozæna.

[1] Cloquet, Osphrésiologie, p. 627.

[2] Archives générales de Médecine, 4e série, vol. viii., p. 174.

[Occasionally a rhinolith is pent up by adhesion between the walls of the nostril.]

Treatment. — The treatment obviously resolves itself into the removal of such concretions as may be discovered, and the careful and thorough washing out of the cavities by means of the nasal douche[1] or syringe.

There may be some difficulty in removing the calculi, especially if they are firmly impacted in the lower meatus, or if they are situated in the upper part of the nose. The most convenient instruments to use are thin-bladed well-curved dressing forceps, and small scoops. But care is requisite in seizing the calculus, otherwise the pressure of the instrument may only serve to push it on more deeply into the cavity. Forceps made into two distinct portions, which may be introduced separately, one on each side of the calculus, and afterwards locked together (like midwifery forceps), would probably prove most applicable. Forceps made on the principle indicated are invaluable for the extraction of foreign bodies through narrow passages. I have used such forceps during several years past for removing foreign bodies from the ears and nose with the greatest ease and most perfect success. Each blade can be in turn insinuated beyond the foreign body or calculus. But in using ordinary forceps one blade is often necessarily withdrawn while the other is being put in position, and as a frequent result the foreign body is pushed further on instead of being seized. Care must be exercised in extracting the calculus lest from its bulk or by the asperities of its surface the surrounding parts should be lacerated.

A case of calculus of the nose is mentioned in the Gazette des Hôpitaux for 1859, in which attacks of intermittent pain occurred. These were at first considered to be neuralgic. Subsequently the symptoms were attributed to necrosis of the nasal bones. Ultimately the calculus was discovered and got rid of by lithotrity at four sittings, at intervals of a fortnight each. The cure was followed by some slight deformity of the nose.

[Sometimes the calculus can be pried out with a blunt instrument after making a short passage for it by passing a knife under the edge of the stone. When pent up by occlusion of the nostrils a preliminary incision is, of course, requisite for access by extracting instruments.]

When the calculus is extracted soothing measures must be adopted, as already indicated, to allay the irritation set up, and to cleanse the cavities. If there is reason to suppose that a gouty diathesis or tendency has contributed to the production or increase of the calculous formation, or if any other constitutional taint is discovered, appropriate general treatment should be prescribed, and thoroughly carried out.

[1] See p. 237.

Epistaxis. Bleeding from the Nose.

The mucous membrane of the nose is very vascular: its bloodvessels are numerous, though none of them are very large; they are derived from many different sources, and they anastomose very freely; they form, especially in the young, important media of communication between the vessels within the cranium and those which are distributed externally. The tissues which support them are in close relation with bone or cartilage, and are subject to injuries, abrasions, and ulcerations; and the vessels themselves are liable to become distended and congested from various different causes. Hence it happens that bleeding from the nose is of very frequent occurrence. In a large proportion of cases such bleeding is of trifling importance. In some cases it seems to afford relief, and to be really beneficial. Sometimes, however, it is symptomatic of visceral disease, or of degeneration of blood. Occasionally, if unchecked, or if frequently recurrent, it may prove serious, dangerous, or even fatal. The blood usually escapes from the nose drop by drop, but sometimes it flows in a fine stream. As a rule it comes from one nostril only, rarely from both simultaneously.

Epistaxis may be "accidental" or "spontaneous" in origin.

Accidental epistaxis resulting from a blow upon the nose, with or without fracture of the bones, is very common. In some boys it may be brought on by a very slight blow, or by any unusual exertion, or even by sneezing, or blowing the nose violently. It rarely goes on to a serious extent.

Spontaneous epistaxis arises from many different causes. It may occur as capillary hemorrhage consequent upon either active or passive congestion; or it may result from ulceration extending into some one or other of the larger vessels; or it may be associated with, and indicative of, the presence of a polypoid growth.

The spontaneous epistaxis so frequently met with among young people of nervous temperament and delicate skin, is one of the most common forms of capillary hemorrhage. It is usually preceded by active congestion, which is sometimes associated with over fulness of the intracranial vessels, and accompanied by flushing of the face, buzzing in the ears, and a sense of heaviness or even severe headache. These

symptoms are commonly relieved by the bleeding.

In young women capillary hemorrhage from the nose is occasionally vicarious of suppressed menstrual flow, and under such circumstances may be considered salutary.

Bleeding from the nose frequently occurs in scurvy, and fever, and in other affections associated with an impoverished state of the blood. In persons of hemorrhagic diathesis it often becomes a source of great anxiety and difficulty.

The epistaxis of declining or advanced life should never be lightly regarded. It is usually preceded by mechanical or passive congestion, which may result from over distension or obstruction of the vessels conveying the blood from the brain, or may betoken the existence of some visceral disease of more or less serious character. The blood that flows is often venous in appearance.

Treatment.—In the treatment of epistaxis discrimination and judgment on the part of the surgeon are demanded as frequently as promptitude and skill. It is one thing to devise and apply the best means for the immediate arrest of the hemorrhage; it is another to decide whether or not it is better to make the attempt. In very many cases the conditions which have given rise to the bleeding require treatment, rather than the incidental and temporary flow of blood which indicates the existence of such conditions. In some instances the non-recurrence of periodical or habitual epistaxis may betoken the approach of danger; and in others the sudden arrest of the bleeding by surgical interference may be followed by symptoms of the gravest import.

Accidental epistaxis may usually be arrested by the simplest means. So also as a general rule may the spontaneous capillary epistaxis of early life. Cold applications to the nose and forehead, snuffing cold water up the nose, the introduction of a piece of ice into the nostril, and such like remedies are generally efficacious. The nursery remedy of slipping a cold key down the back, or far better, of suddenly dashing cold water over the spine, seems sometimes to answer almost magically;—possibly, as has been suggested, through some reflex action excited in the vaso-motor nervous system. In some cases the vertical elevation of the arms as high as possible above the head is successful. The rationale may be considered doubtful, but the fact appears to be well established. This plan has been especially recommended (if not first suggested) by Dr. Negrier, of Angiers,[1] who states that he has never known it fail to arrest the bleeding. It sometimes answers in cases of severe injury. Malgaigne mentions the case of a young man who had sustained a severe fracture of the nose. Cold lotions, etc., failed to arrest the copious bleeding which ensued. The patient was directed to raise his arms perpendicularly. The hemorrhage ceased almost immediately, and did not recur. Dr. Keith, of Aberdeen, speaks most strongly of the excellence of this method. Another simple and often very effectual method consists in firmly compressing the nostril of the affected side against the septum. Observation teaches that in a large number of cases the bleeding spot is somewhere near the anterior and lower borders of the septum. In such cases it is obvious that the hemorrhage may be arrested by pressing upon the nostril or nostrils with the finger, or with the finger and thumb. The compression should be maintained for a quarter of an hour or more, and then gently relaxed. The patient should be warned against sneezing or blowing the nose for some time after the pressure has been removed. The efficacy of the method is established by ample experience. Dr. Chapman recommends the application of an India-rubber bag containing water of a temperature of 115° to the back of the neck, and gives some remarkable instances of the success of this mode of treatment.[1] Dr. Graves[2] speaks very highly of the good effects of dry cupping in some forms of epistaxis. In all cases the head should be maintained in the natural erect position. If the head is bent forwards the large venous trunks may be obstructed, and congestion and continuance of the hemorrhage consequently favored. If the head is thrown backwards or the patient is in the recumbent position, the blood may flow backwards, and almost imperceptibly trickle down the pharynx long after all bleeding may be supposed to have ceased.

If none of these simple methods prove effectual, a stream of cold water containing in solution some astringent may be directed into the nostril. This may be accomplished by means of an ordinary syringe, or better still by the nasal douche (see p. 237). Or some astringent, as the persulphate or perchloride of iron, or burnt alum, or tannic acid, on a dossil of lint or a piece of sponge, may be applied to the interior of the nostril; or powdered matico, or tannic acid or persulphate of iron, may be introduced either mechanically or by insufflation. But such means, however certainly effectual, should not be

[1] Watson, On the Principles and Practice of Physic, vol. ii., p. 795.

[1] See Medical Mirror, February 1, 1870, p. 25.

[2] Clinical Lectures, vol. ii., p. 316.

recklessly adopted. I have known the introduction of matico cause the immediate arrest of the hemorrhage with the after consequence of most alarming symptoms.

If these means fail, there remains to the surgeon the easy and certain expedient of plugging the anterior and posterior nares. When this is done it is physically impossible for the hemorrhage to continue after the nasal cavity is once filled. For want of knowledge of this method more lives than one have been sacrificed. Gross refers to several examples.[1] Two have come under my own cognizance.

The operation of plugging the nares is best performed by means of Bellocq's sound. This consists of a silver canula (slightly curved at the distal end, and six or eight inches in length), within which freely slides a stylet some four or five inches longer than the canula. The proximal portion of the stylet is rigid to an extent corresponding in length to the straight portion of the canula. Its distal portion is made of a piece of "mainspring" which tends to curve round in the proper direction, and is terminated by a perforated button. The operation is performed as follows. The eye of the button is threaded by a long piece of strong silk, and the stylet is drawn up until the button lies against the end of the canula. The instrument thus armed is passed along the floor of the nose into the pharynx. The stylet is then pushed along the canula, and the spring turns round the posterior border of the velum into the mouth. The silk is seized and drawn out through the mouth, and a portion of sponge of sufficient size to fill the naso-pharyngeal opening somewhat tightly is attached to it. The instrument is next withdrawn, carrying with it through the nostril the other end of the silk. By means of traction upon the silk and manipulation with the finger, the piece of sponge is then fitted into the naso-pharyngeal opening in such a manner as to block it up completely. Lastly, a second plug of lint or sponge is attached to the other end of the silk, and firmly fitted into the nostril. It is obvious that this operation may be accomplished as effectually, though perhaps not so easily, by various other instruments, as for example a long bent probe, the stripped feather portion of a quill, or a gum elastic catheter. The last named instrument properly threaded throughout its length, and carrying a loop of silk hanging through its eye answers extremely well. [A flexible-eyed probe, formed of wire covered with a gutta-percha preparation, forms the most convenient appliance for the purpose, especially in children. The eye being threaded, the probe portion is passed along the floor of the nares, and drawn out through the mouth, thus obviating its withdrawal through the nasal passage.] The plugs should not be allowed to remain more than about forty-eight hours, for they are necessarily a source of discomfort and irritation, and are liable to give rise to the formation of matter, which may speedily become offensive, and possibly poison the system. Professor Gross[1] says: "I have seen several cases where from this cause the patient lost his life, being seized with a low form of fever, attended with delirium, which nothing could arrest. In one of the cases there were marked symptoms of pyæmia." The plugs may be easily removed by cutting the silk which connects them, withdrawing the anterior plug from the nostril, and pushing the posterior one on into the pharynx, and bringing it out through the mouth by the finger, or a pair of vulsellum forceps, or by means of one end of the silk, which may have been left to hang through the mouth. After the removal of the plugs the cavity of the nose should be thoroughly but gently washed out.

In all cases of frequently recurring epistaxis, and especially in those which depend on constitutional causes, it is of great importance to carry out the general treatment which the circumstances of the particular case may indicate. Rest, avoidance of excitement, and general hygienic measures must be enforced. In some cases it may be desirable to administer gallic acid or acetate of lead for a time; but much more frequently, especially if the strength has been reduced by repeated bleeding, ferruginous preparations, and *par excellence* the tincture of the perchloride of iron, are indicated.

It is almost needless to add that if the epistaxis is due to the presence of a polypus, or to any specific ulceration, no permanent good can be effected until the polypus is removed, or the ulceration is partially or completely healed.

Coryza.

The term coryza designates a symptom rather than a disease. It implies an excessive discharge of mucus, or "running" from the nose. The discharge may be watery and clear, or glairy and thick, or even muco-purulent. It may depend upon catarrhal, strumous, or syphilitic affections, or upon the presence of a polypus. So long as there is no well characterized fetor, the term coryza is applicable. But

[1] System of Surgery, vol. ii., p. 366. Philadelphia, 1872.

[1] System of Surgery, vol. ii., p. 366. Philadelphia, 1872.

if the discharge becomes horribly offensive, or if it has been so from the first, the term "ozæna" is employed.

Catarrhal inflammation of the pituitary mucous membrane, or to use the popular designation "a cold in the head," is by far the most frequent cause of acute coryza. This common malady needs no discussion here; but it is worthy of note that many different affections of the nasal mucous membrane, and even polypoid growths, are often incorrectly described as taking origin from "severe and repeated colds." In some instances, doubtless, such an explanation is correct. But in others the coryza and other symptoms are the effects and indications, rather than the causes of the development of the special malady that may have arisen.

Chronic catarrhal inflammation is often attended by troublesome persistent coryza, and associated with more or less inflammatory thickening of the mucous membrane, and consequent obstruction to free respiration. This condition is most liable to supervene in delicate strumous children, or youths of either sex. In some cases local treatment by means of mild astringent washes, or the insufflation of powders of similar character, conjoined with general measures, appears to be beneficial. A warm dry atmosphere, good nourishment, tonics, and cod-liver oil are indicated in most cases of long standing. Occasionally superficial ulceration occurs in cases of simple catarrhal inflammation, whether very acute or of long standing. But such ulceration as a rule is very slight, and, although painful for the time, very soon heals. It rarely causes the discharge to become fetid.

Hypertrophy of the Pituitary Membrane.

The pituitary membrane sometimes becomes thickened and hypertrophied throughout the whole or greater part of its extent, both nostrils being equally affected. More frequently, however, the thickening is limited to those portions of the mucous membrane which cover the inferior turbinated bones. The mucous membrane of these parts is naturally thick; and its thickness depends, according to Kölliker,[1] not only upon its numerous glands, but also upon the presence of abundant, almost cavernous, venous plexuses in its substance. This affection is always associated with coryza. Sometimes it follows long-continued coryza. Sometimes it appears to rise spontaneously, from some general or constitutional, rather than local, cause. But in such case it is usually attended by more or less copious watery or mucous discharge, although the tumefaction itself occasionally appears dry on the surface. The other symptoms usually are a sense of discomfort, more or less interference with free respiration, and a variable degree of alteration of the voice. On [anterior] inspection a red opaque swelling may be seen, somewhat velvety in appearance, and solid to the touch. The extent as well as the precise situation of the swelling varies in different cases, but it is usually symmetrical. Sometimes the turbinated bones are themselves affected, and become unnaturally soft, porous, and swollen. This affection, especially if confined to the mucous membrane covering the anterior and lower parts of the turbinated bones, may be mistaken by the patient, and even on casual examination by the surgeon, for polypus. But there is no difficulty in making the diagnosis. The non-pedunculated, broad attachment of the swelling, its immobility during respiratory efforts and on pressure by the probe, together with its redness and opaque (not semi-transparent, glistening) appearance, serve to distinguish hypertrophy of the mucous membrane from polypus. It is important, however, to bear in mind that this condition may be, and indeed often is, concomitant with the existence of polypus in the upper part of the nasal cavity, and that its presence may conceal the polypus from view.

A case recently came to my knowledge in which a surgeon removed a small polypus from a patient who was also suffering from hypertrophy of the mucous membrane. Another surgeon seeing the case declared that there was no polypus, that a grave mistake had been made, and that no operation ought to have been performed. The consequences were not satisfactory. The polypus was allowed to increase, to the extreme discomfort of the patient, until its existence became indisputable, and its removal far more difficult than it would have been at an earlier period.

[Rhinoscopic inspection often reveals extensive exuberance of lax tissue over the inferior turbinated bone, totally inaccessible to direct vision anteriorly. This examination should never be neglected. It will often differentiate the condition under discussion from that of neoplasm.]

Treatment.—The hygienic measures suitable in strumous affections generally may be recommended. Cod-liver oil and the syrup of the iodide of iron often seem to do good. Locally, a single leech may be applied to the swollen membrane, or numerous fine punctures may be made with a needle. Such measures are sometimes obviously beneficial. Styptic and astrin-

[1] Manual of Human Histology (Sydenham Soc. Translation), vol. ii., p. 417.

gent solutions may be injected or applied by means of a camel's-hair brush. Or the surface may be touched from time to time with solid nitrate of silver. As a general rule, however, whatever treatment be adopted, the case is likely to prove tedious and troublesome.

In a case detailed by M. Nélaton,[1] the nostrils were obstructed to such an extent that it was found necessary to remove portions of the bones as well as of the hypertrophied mucous membrane. This was done by means of scissors. The result appears to have been satisfactory, but treatment so severe is very rarely indeed necessary.

Syphilitic Affections of the Mucous Membrane of the Nose.

Various syphilitic affections of the mucous membrane of the nose, with or without ulceration, are often attended by obstinate coryza. Such affections occur commonly during the secondary stages of the malady, and are to be distinguished from those more serious affections which arise during the tertiary stages, and which commence as a rule in the deeper structures. Sometimes, however, in the secondary stages, ulceration, at first comparatively slight and superficial, if unchecked by treatment may penetrate deeply, and involve to some extent the bones or cartilages. In such case the inoffensive coryza may give place to an almost intolerable ozæna. This is especially liable to happen in strumous subjects. Syphilitic coryza commences like a common cold in the head, with increased secretion of mucus, which for a long time remains clear, and of the consistence of thin starch. The discharge is increased by exposure to cold, and by indulgence in alcoholic drinks. If the patient should happen to take cold, the discharge becomes profuse, ropy, opaque, and yellowish or greenish in color. More or less uneasiness and tenderness are felt in the nostrils, together with a sense of stuffiness or obstruction. The discharge abates at intervals, especially during sleep; the pituitary membrane feels drier than natural, and crusts of dried mucus are found below the inferior turbinated bone. The patient is frequently inclined to blow his nose to clear it of the excessive secretion, and sometimes traces of blood appear in the handkerchief. On rhinoscopic inspection the mucous membrane is seen to be of a darker or deeper red than natural, and here and there superficially eroded. A similar condition may extend throughout the recesses of the nasal cavities, and into the ethmoidal cells, and the frontal and maxillary sinuses. It may be attended by headache, alteration in the character of the voice, and impairment or abolition of the sense of smell. Sometimes it appears late; and it often obstinately persists long after all other secondary symptoms have subsided.

Treatment.—The administration of mercury is requisite, or at any rate more likely to prove speedily efficacious, than any other mode of treatment. In cases of long standing, in which the syphilitic symptoms generally have disappeared, this alone persisting, small doses of the bichloride may be given twice daily in a couple of ounces of distilled water, and persevered in if necessary for two or three months, as recommended by Mr. Ure. Or a single grain of blue pill or gray powder may be given every night for a similar period. In the more recent cases the use of the calomel vapor bath[1] is especially to be recommended. The inhalation into the nose of the mercurial vapor produces a well-marked beneficial effect. Mercurial lotions, injected or applied by means of a camel's-hair brush, are useful. All crusts and accumulations of secretions should be washed away by syringing, or by the douche. Mild astringent or detergent solutions should be used. Any ulcers or erosions that can be seen, and reached by the aid of the rhinoscope, may be advantageously touched with nitrate of silver, or sulphate of copper.

Syphilitic Coryza in the Infant.

Coryza accompanied by the characteristic snuffling and difficulty in sucking is in a large proportion of cases among the earliest indications of congenital syphilis. In addition to the ordinary constitutional treatment, careful but thorough syringing through the nostrils is especially to be recommended. Weak solutions of chlorate of potash or borax may be advantageously used as washes. When the discharge is cleaned away, it is often a good plan, if practicable, to pencil over the mucous membrane, where it may seem to be fissured or ulcerated, with a weak ointment of nitrate of mercury and oxide of zinc.

If the discharges are not carefully washed away, they not only tend to irritate and empoison the hitherto unaffected parts, but they are liable to become highly offensive. When once the ozænic condition is fully established, the treatment of the case becomes much more

[1] Clinical Lectures (American Translation by Atlee), p. 414.

[1] See Mr. Lee's article on Syphilis in the first volume of this work.

difficult and tedious, and the probable ultimate result much more serious. The bones and cartilages, even if they escape actual destruction by caries or necrosis, may fail to become fully and perfectly developed, and the nose may consequently present in after life the characteristic appearances of the *nez écrasé*.

Ozæna.

The term "ozæna," like "coryza," designates a symptom rather than a disease. It implies a fetid discharge from the nose, which communicates an almost intolerable odor to the breath. The discharge varies in character and quantity in different cases, and under different circumstances. It may be thin and sanious, or thick, tenacious, and semi-purulent; almost colorless, or yellowish, or greenish yellow, or stained with blood; it may be scanty or profuse; sometimes it quickly dries up into thick hard crusts; sometimes the crusts formed are few and thin. But in every case there is a characteristic, though somewhat variable, offensive odor, which often embitters the life of the sufferer by rendering him repulsive to all about him.

Ozæna arises from various causes, and is associated with many different conditions. The treatment requisite varies with the cause of the malady, and the constitutional and local conditions present. It is therefore of the highest importance to form, if possible, an accurate diagnosis, and not to rest satisfied with simply designating as "ozæna" every offensive discharge from the nostrils. Weber[1] considers it would be well "to reject the term altogether, since it serves, as a rule, as a cloak for incomplete diagnosis." In all cases careful and thorough rhinoscopic examinations should be made from time to time.

Among the common causes of ozæna may be enumerated syphilitic, strumous, and lupous ulcerations of the mucous membrane, with or without caries and necrosis of the bones and cartilages; the presence of foreign bodies; and the retention of fragments of bone that may have become necrotic or carious as the result of injury. There remain, however, a considerable number of cases not assignable to any one of these causes, nor, indeed, to any other cause at present well made out. To such cases the term *idiopathic* or *constitutional ozæna* is applied.

[1] In his excellent article on "Diseases of the Nose," in the Handbuch der allgemeinen und specialen Chirurgie. Pitha und Billroth: Erlangen, 1866. Band iii., p. 187.

Ozæna must be carefully distinguished from foulness of breath depending upon carious teeth, ulcers in the mouth, affections of the tonsils, etc. The distinction may generally be made by noticing the effect produced when the mouth and nose are closed alternately. In ozæna the odor is most perceptible when the mouth is closed, and the patient breathes through the nose. The opposite is the case in affections of the mouth, etc. A source of fallacy sometimes arises from the dribbling or falling of the nasal discharge into the pharynx.

Treatment.—The treatment requisite depends obviously upon the cause to which the discharge is attributable, as well as upon the local and constitutional conditions with which it is associated. But certain general principles and methods of treatment are more or less constantly applicable in all cases. These may be advantageously described at once. The more special indications are stated in connection with the descriptions given of the several affections which are liable to be, and very commonly are, accompanied by ozæna.

In all cases, proper constitutional treatment is of very great importance; but it rarely proves of much avail, unless the necessary local treatment is fully carried out.

In the local treatment of ozæna, from whatever cause, the general indications are—first, to remove all possible sources of irritation and obstruction, whether crusts of dried mucus, sequestra of bone, or foreign bodies; secondly, to deodorize the nasal cavities, and to wash away all foul discharges so frequently and thoroughly as to prevent any accumulation taking place; thirdly, to modify the special morbid condition of the parts from which the discharge is derived.

These indications may be generally more or less completely fulfilled,—first, by any needful use of forceps or other surgical instruments; secondly, by washing out the nasal cavities; thirdly, by inhalation of vapors; fourthly, by insufflation of powders.

The nasal cavities may be washed out either by means of a syringe, or by the nasal douche. The syringe should have a long slender nozzle with a bulbous extremity, perforated by a rose of small holes. Such a nozzle, connected with a small hand-ball enema- or injection-syringe, forms a very useful and generally applicable instrument. But in a large proportion of cases, no amount of syringing is so effectual, not to say so easy, as the use of the nasal douche. This method of washing out the cavities of the nose is a practical application of a physiological

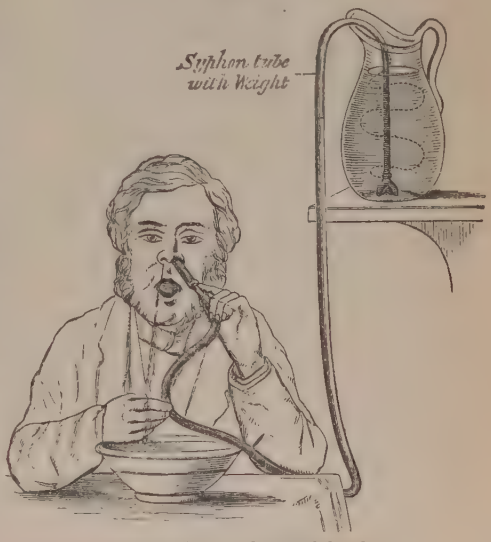
fact discovered by Professor Weber of Halle.[1] It was some years ago introduced to the notice of the profession by Dr. Thudichum, to whom every acknowledgment is due.[2] But at present it appears to be less generally known and adopted than it deserves to be. Its value in some cases can scarcely be exaggerated. Indeed, its introduction may almost be said to have done as much to improve the treatment of certain diseases of the nose, as the posterior rhinoscopy of Czermak has done to aid their diagnosis.

The apparatus needful for the nasal douche consists simply of a cylindrical nozzle of horn, vulcanite, or glass, rounded and perforated at one end, and by the other connected with one extremity of a yard or two of elastic tube, through which a constant stream of liquid can be kept up from some appropriate vessel by hydraulic or atmospheric pressure. The nozzle should be three or four inches in length, and of such calibre at its rounded extremity as to fit accurately in the nostril of the patient who is to use it. The close application of the inner walls of the nostril to the nozzle is a matter of considerable practical importance. It is therefore necessary to have nozzles of different sizes for different cases. The rounded end should be perforated by five or six small holes. The elastic tube should be intercepted by a stopcock at a short distance from the nozzle. The far end of the tube may open into the bottom of the India-rubber bag or glass receptacle on stand, as recommended by Dr. Thudichum; or it may be connected with a piece of metal tube, bent syphon-like, or terminated by an inverted funnel-shaped metal, glass, or earthenware footpiece, which may be sunk in the liquid contained in a jug or any convenient utensil.

The method of using the nasal douche is illustrated by Fig. 298. The receptacle is filled with the liquid to be used, and placed on a level somewhat above that of the head of the patient. The precise height may be varied according to the degree of force with which it is desired that the stream should flow.

The tube is either filled by the simple descent of the fluid, or, if the syphon action is adopted, by pouring a sufficient quantity of fluid into it, and then immersing the footpiece in the jug, etc., or by drawing fluid into the tube, after the footpiece has been immersed. The stopcock is then shut off; and the nozzle is

Fig. 298.



Method of using the nasal douche.

inserted well into the nostril of the patient, and held by the corresponding hand. The other hand controls the stopcock.

The patient, seated before a basin, and holding his head in its natural erect position or slightly inclined forwards, opens his mouth widely, and breathes through his mouth only. The stopcock is then turned, and a stream of liquid enters the nostril, fills to a certain extent the corresponding nasal cavities, passes round the posterior border of the septum, and finally issues from the other nostril, after having more or less completely washed the nasal cavities on both sides. The force and fulness of the stream may be regulated by the stopcock, and also by varying the height of the receptacle above the head of the patient. The extent to which the cavities are filled depends in some degree upon the position of the head. By momentarily compressing the open nostril the fluid may be made to rise higher than it otherwise would.

It is sometimes almost astonishing to

[1] "Some years ago it was discovered by Professor Weber, of Halle, that when one side of the nasal cavity is entirely filled through one nostril with fluid by hydrostatic pressure, while the patient is breathing through the mouth, the soft palate completely closes the choanæ, and does not permit any fluid to pass into the pharynx, while the fluid easily passes into the other cavity, mostly round and over the posterior edge of the septum narium, and escapes from the other open nostril, after having touched every part of the first half of the cavity of the nose, and a great part—certainly the lower and median canals—of the second half."—Thudichum, On Polypus in the Nose and Ozæna, p. 17. (Churchill, 1869.)

[2] Lancet, November 24, 1864.

witness the quantity of crusts and foul discharges that may be thus washed away with the greatest ease, and with no discomfort to the patient. So long as respiration is carried on through the widely-opened mouth, scarcely a drop of fluid escapes into the lower parts of the pharynx. The moment the mouth is closed, the soft palate falls, and all the disagreeable indications of downward flow of fluid occur. The liquids to be used with the nasal douche must be varied from time to time, according to the nature and condition of the case. But in all cases some saline solution should be used, rather than plain water, which is found to irritate the mucous membrane much more than a solution of higher specific gravity. As a general rule, about a teaspoonful of common salt, or of a mixture of equal parts of common salt and phosphate or carbonate of soda, to a pint of water forms the best ordinary wash. The slight alkalinity of the solutions of phosphate and carbonate of soda helps to soften the crusts. To such solutions as bases, various deodorizing, detergent, astringent, or "alterative" remedies may be added, according to the indications afforded in each particular case.

It is scarcely necessary to add, that this method is not applicable in cases in which the soft palate is destroyed, nor in those in which either side of the nose is absolutely, or even very nearly occluded. In cases in which the septum is extensively perforated the method is useful, but it obviously loses more or less of its full efficacy.

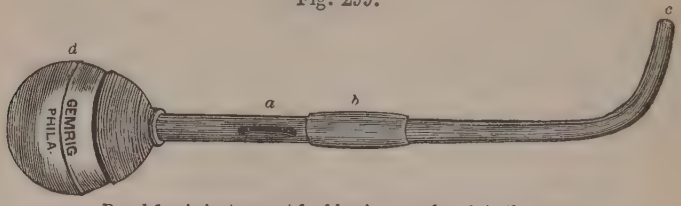
The inhalation of vapors or of "atomized" fluids is sometimes very useful. If such vapors should be of irritating character, it may be a good plan to direct their passage, and to defend other parts, by inserting into each nostril little hollow cones such as may be readily extemporized by folding round a piece of card or paper.

[In using atomized liquids, a coarse spray should be employed, propelled with considerable force—first into one nasal passage, and then into the other; the operation being continued in each instance until the liquid flows freely out of the nostril of the opposite side.

Frequent examinations, anteriorly and posteriorly, are requisite for certainty as to the efficacy of either douche or spray.]

The insufflation of powders may sometimes be accomplished by their being "snuffed" up by the patient. But this is a comparatively ineffectual way in any case, and altogether inapplicable if the nasal cavities are obstructed. A far better plan consists in blowing the powder up through a small tube inserted into the nostril. A piece of glass tube properly curved, or even a quill, with a bit of India-rubber tube attached [or the rubber tube alone], forms an efficient instrument easily extemporized. The most perfect instrument for the purpose is that which bears the name of Rauchfuss's Insufflator (Fig. 299). The powder is introduced into

Fig. 299.



Rauchfuss's instrument for blowing powders into the nose.

the tube through the opening (*a*), which is then covered over by the sliding tube (*b*), the extremity (*c*) is introduced into the nasal cavity, and then by a sudden compression of the India-rubber ball (*d*) the powder is driven out, and diffused in all directions.

[A similar canula with a flexible tube at the proximal end instead of a ball, can be used with more accuracy. Some surgeons employ their own breath as the propelling force; but compressed air from a condenser, or foot or hand bellows, is more cleanly, and far preferable.]

Syphilitic Ulceration, Caries, and Necrosis.

The comparatively superficial syphilitic affections of the mucous membrane already referred to (p. 235), if unchecked by treatment, may gradually go on until deep and extensive ulceration results, and the bones and cartilages are more or less seriously implicated or destroyed. In such cases the coryza of the earlier stages gives place to ozæna; and sooner or later the general conformation of the nose may be changed. These results occur, as already stated, not only in acquired, but also in congenital syphilis. All cases of long-continued syphilitic coryza, followed, in spite of treatment, by ozæna, demand the most careful watching and skilful management on the part of the surgeon. In such cases intracranial mischief of the most serious character sometimes supervenes. Numerous examples are given by Dr. Weber in his paper on this subject in

the forty-third volume of the Medico-Chirurgical Transactions. Occasionally pyæmia is set up.

In a case mentioned by Dr. Weber, cessation of the sanious ozænic discharge was soon succeeded by head symptoms; four days later the patient was seized with rigors. Other indications of pyæmia came on. Death occurred on the thirteenth day after the first rigor. Post-mortem examination revealed thromboses of the left ophthalmic vein and cavernous sinus, together with purulent meningitis about the under surface of the left cerebral lobe. Secondary abscesses were found in the lungs and liver, and purulent effusion in the left pleura.

The most destructive syphilitic affections of the nose, however, arise, as a rule, during the tertiary stages of the malady, and are most liable to occur in strumous subjects. It would appear that these affections generally commence as gummatous periostitis [1] Caries and necrosis of the bones, softening down of the effused material, ulceration of the mucous membrane, and discharge of matter in turn ensue. The discharge is very offensive. The disease advances more or less rapidly, until the vomer, the perpendicular plate of the ethmoid, more or less of the cartilaginous septum, and the turbinated bones, as well as the floor of the nose and other parts may be destroyed. But it is very rarely, if ever, that the experienced surgeon has the opportunity of tracing from the commencement the progress of the malady. He *sees* the more or less direful results of want of proper treatment, or the effects of mismanagement. He can often only *guess* what may have been the early history of the case. Sometimes the bones are destroyed piecemeal, and numerous small fragments exfoliate one after another. Sometimes considerable portions become at once necrotic. Every pathological museum contains illustrative specimens, and almost every hospital surgeon of experience has met with examples.

The most serious consequences may follow either from extension of the mischief to the interior of the skull, or from some incidental or accidental complication.

Trousseau mentions a case in which a large irregular portion of the ethmoid (at least a fourth part of the whole bone) fell through the posterior nares into the throat and almost caused suffocation. The patient died next day with cerebral symptoms, probably due to extension of inflammation through the cribriform plate.[2]

But short of such fatal results, the loss of portions even of the bony and cartilaginous parietes of the nose is liable to be followed by permanent deformity, which may be more or less serious. It therefore behoves the surgeon to foresee, and, if possible, to avert by vigorous and judicious treatment the impending dangers.

It was formerly the custom to attribute the ravages of syphilis, in the nasal region especially, to the abuse of mercury rather than to the disease itself. But I believe most surgeons are now agreed in considering such an opinion erroneous. Many cases of syphilitic caries and necrosis, attended by deformity, are on record, and others present themselves from time to time in which there is no evidence whatever that mercury has been administered, but rather the opposite.

Sir Benjamin Brodie mentions a good example. A gentleman had a chancre. No mercury was given. Two years afterwards he had extensive disease of the bones of the nose. Epilepsy, mania, and death ensued. Sir B. Brodie had no doubt but that the disease extended through the cribriform plate of the ethmoid, and ultimately affected the membranes and the brain.[1] Dr. Graves alludes to two analogous cases, in each of which it is worthy of note that the strumous diathesis was pre-eminently marked.[2]

The diagnosis of syphilitic disease of the nose is not as a rule difficult; but sometimes it is necessary to be very cautious in forming an opinion. It must be borne in mind that caries and necrosis of the bones of the nose, accompanied by ozæna, arise from various other causes as well as from syphilis.

The history of the case, the aspect of the patient, the presence of other symptoms, especially of general syphilitic cachexia, the extent of the mischief, etc., afford most important aid in the diagnosis.

Ulcers, periosteal swellings, perforations of the septum, portions of necrosed or carious bone, etc., if present, can often be more or less readily seen on rhinoscopic inspection, or felt on exploring the cavities with the fingers or probe. Sometimes, however, comparatively little can be discovered beyond the ozænic discharges and crusts, and some swelling, with at most superficial erosions of the mucous membrane. But it must not be hastily assumed that neither deep ulceration, nor necrosis, nor caries exists. For the parts affected may be high up in the nose, or concealed from view by the swelling of other parts, or by the presence of the discharge. It is probable that in all cases

[1] See the article by O. Weber, in "Pitha und Billroth," op. cit., p. 189.

[2] Clinique médicale, tome i., p. 546. Paris, 1868.

[1] London Medical Gazette, 1844.

[2] Clinical Lectures, vol. ii., p. 484.

of syphilitic ozæna there is deep ulceration of the mucous membrane, and in a large proportion of cases the bones are more or less seriously implicated. It is easy to understand how a small sequestrum of bone may remain hidden in one of the recesses of the nose, and yet serve to keep up the offensive discharge.

Syphilitic periostitis of the bones of the nose is usually attended by violent racking pain in the nose and forehead. In some cases in which the nasal bones, and nasal processes of the superior maxillary bones are affected, there may be more or less swelling visible externally, accompanied by pain, tension, and tenderness. The local pain is often associated with severe syphilitic headache, and the sufferings of the patient are extreme, especially so when he is warm in bed.

Treatment.—The importance of local treatment can scarcely be exaggerated. But while such treatment is being carried out, it is almost equally important that appropriate constitutional remedies should be administered.

The local treatment essentially consists in the removal of all sources of irritation, as dried crusts of foul mucus, loose fragments of bone, etc., and in washing away the discharges so frequently and thoroughly that they have no time to accumulate and decompose.

Careful inspection and exploration of the nasal cavities should be made from time to time; periosteal abscesses should be opened early by the knife; all loose or carious fragments of bone should be removed by the forceps or other instruments as soon as they are discovered. Ulcers may be touched with nitrate of silver, or sulphate of copper. A long probe, one extremity of which has been dipped into a little fused nitrate of silver, forms the most convenient caustic-holder for this purpose.

The nose should be frequently and thoroughly washed out, either by the nasal douche, or, if the septum is extensively destroyed, by means of a syringe with a long nozzle. Solutions of chlorinated soda, or of permanganate of potash, may be added to the simple saline basis already described (p. 238). Or chlorate and permanganate of potash together, or chlorinated soda and borax, in solution, may be advantageously used. Dr. Thudichum especially recommends the permanganate. In some cases a weak solution of the bichloride of mercury, or the common yellow lotion is of service. After the nose has been thoroughly washed, the immediate inhalation of the vapor of iodine, or the insufflation of Trousseau's mercurial powder,[1] often proves very beneficial. The inhalation of iodine is most useful in the tertiary stages of the malady, the mercurial insufflation in the secondary stages.

The constitutional treatment must be regulated in accordance with the stage of the malady and the condition of the patient. In the secondary stages, especially if the bones and cartilages are not implicated to any formidable extent, mercurials are indicated. They may be administered either in small doses taken internally,[1] or by inunction; or the calomel vapor-bath may be employed. The last method has the advantage of conjoining local with general treatment, inasmuch as the patient may inspire some of the vapor into the nose. This treatment must be very carefully watched.

In the tertiary stages, in which the affection has commenced as a periostitis, and especially if the bones and cartilages are extensively destroyed, or if the mercurials have already been administered at an earlier period, iodide of potassium is indicated, and mercurials are likely to prove prejudicial. The iodide of potassium should be given in full doses (grs. xx to grs. xxx or even more) three or four times a day. It may be conjoined with iodide of iron and cod-liver oil. These remedies are particularly valuable in cases in which there is pronounced cachexia and great loss of strength. Other tonics, as dilute nitric acid, quinine, etc., may often be advantageously given.

Lupous and Strumous Ulceration, etc., accompanied by Ozæna.

Lupus, as already stated (p. 218) may first attack the mucous membrane of the nose. In this case the diagnosis is not always so easy as when the skin is primarily affected.

Lupus exedens commencing in the mucous membrane corresponds very closely to the affection that has been described by Mr. Ure[2] and other authors as "*erosive ulcer of the follicles.*" The earlier symptoms resemble those of a simple catarrhal affection of the pituitary membrane. The mucous membrane covering the cartilaginous septum usually suffers first. The patient experiences a certain degree of tenderness and sense of fulness, especially after exposure to cold air; and a constant inclination to blow the nose, or to pick away the crusts which are constantly reproduced. Small red angry-looking tubercles can be seen on inspection, and these sooner or later give place

[1] Red or white precipitate, 1 part; finely-powdered sugar, 60 parts. Op. cit., p. 547.

[1] See p. 235.

[2] See first edition of this work, vol. iii., p. 194.

to spreading ulceration. But the ulcers preserve to some extent their tubercular character, and the apices of the tubercles are concealed by dry, hard, tenacious crusts. As the ulceration proceeds, the cartilage suffers, and the septum soon becomes perforated, especially if the mucous membrane has been affected simultaneously on both sides. By further extension one ala or both may be destroyed, and the bones may be implicated. Still later, very serious deformity may ensue from the falling in of the bridge of the nose, or from the extension of the disease to the external parts. The discharges vary in offensiveness in different cases, and at different periods.

It is of the highest importance to distinguish affections of this kind from those that are of syphilitic origin. If such distinction is not made, very unjust suspicions may attach to the character of the patient; and the surgeon may be induced to adopt a line of treatment which may prove positively injurious. In making the diagnosis attention must be directed to the history of the case, the age of the patient, the absence of other symptoms of syphilis, and especially the absence of the characteristic cachexia which almost always accompanies the most serious syphilitic affections of the nose, and also to the comparative slowness with which the malady has progressed, and the lateness of the period at which the bones have become affected. The presumptive evidence thus acquired as to the nature of the case receives ample confirmation if the little papillary infiltrations of lupus can be recognized, and the tubercles present a compact granulous appearance; and still further if the disease progresses very slowly, and there is a manifest disposition to healing here and there, even while the ulceration is extending.

The treatment of lupus has been already fully discussed (p. 220). It may be added, however, that the actual cautery in the form of the galvano-caustic pencil, or platinum wire, or the red-hot iron, is especially well adapted for the destruction of lupus within the nose. Caustic potash and chloride of zinc are not so readily controlled. From their deliquescence they are apt to run over the healthy parts. Solid nitrate of silver, thoroughly and repeatedly rubbed in, is sometimes efficacious. Mr. Ure recommends the application of a thin layer of a paste composed of one part of chloride of zinc with two or three parts of gypsum or powdered tragacanth, with a little alcohol. Sometimes after the ulcers are healed, a sense of rawness or tenderness of the pituitary membrane remains, depending upon chronic inflammation. In such cases, mild astringent washes are useful; and the nostrils may be advantageously plugged with loose dossils of cotton wool, so as to obviate irritation from the passage of cold air.

Ozæna, associated with Ulceration, Caries, and Necrosis from other causes.

Simple catarrhal ulcerations of the mucous membrane are usually only superficial erosions, and are rarely accompanied by ozæna. In some cases, however, they precede, or are associated with, the so-called idiopathic ozæna described in the next section.

As a rule they heal speedily under simple treatment, when they are not irritated by "picking" on the part of the patient, or undue interference on the part of the surgeon.

Ulceration of the mucous membrane, with more or less extensive destruction of the cartilages and bones, sometimes occurs among the sequelæ of severe fevers—as scarlet fever, measles, smallpox, typhus, and, more rarely, perhaps, erysipelas and chronic pyæmia. The affection may begin during the height of the fever with swelling of the mucous membrane, accompanied by pain in the part affected and in the forehead, and headache. There is often œdematous swelling of the lower part of the nose and upper lip. Subsequently abscesses may form, and the cartilages and bones may become implicated, and perforation of the septum may result. The perforation is generally more or less circular, and has but little disposition to extend.

Injuries followed by necrosis, abscess, and the retention of sequestra of bone, are not uncommon causes of ozæna.

Foreign bodies retained in the nasal cavities are very liable to cause ulceration, caries, and necrosis, and to give rise to distressing and obstinate ozæna. In such cases the presence of the foreign body is often unsuspected, and only discovered after a long period of suffering on the part of the patient.[1] The necessity for careful examination, and the treatment required, are sufficiently obvious.

Idiopathic or Constitutional Ozæna.

There remain certain cases, and these not a few, in which, even after the most

[1] A very remarkable illustration is afforded by a case detailed by Dr. W. Hickman, in which a steel ring was removed from the posterior nares of a girl sixteen years of age, after having been lodged there for more than thirteen years, during which period it had occasioned horrible ozæna and other severe symptoms.—British Medical Journal, Sept. 28, 1867.

careful and repeated inquiries and examinations, the surgeon may utterly fail to discover any obvious cause of the horribly offensive discharge from the nose which renders the patient's life miserable, and his society almost unendurable. Neither caries nor necrosis of the bones can be made out, nor even ulceration of the mucous membrane, or at most only superficial excoriation. But the mucous membrane generally appears unnaturally and irregularly reddened, and often attenuated and atrophied in some parts and swollen in others. The odor of the discharge is altogether indescribable, but it cannot be mistaken.[1] The discharge varies in abundance, and the crusts which are formed vary in thickness and dryness. The discharge often becomes worse in young women during the menstrual periods.

It has been suggested in explanation of this form of ozæna that there may exist some anomalous condition of the secretions which renders them liable to undergo a peculiar process of decomposition, and that such condition depends upon some unexplained constitutional cause. It has also been suggested that the offensiveness of the discharge from the nose may be considered analogous to the somewhat similar offensiveness of the perspiration of the feet, axillæ, etc., not unfrequently met with in persons who are nevertheless scrupulously cleanly in their habits. It seems to me not improbable that, at any rate in some cases, the affection may really be the result of a form of lupus non exedens implicating chiefly the mucous membrane of the upper and back parts of the nasal cavities. The age at which the affection commonly commences, the constitutional diathesis with which it is associated, the comparatively slight detriment to the general health, its obstinate persistence, the appearance of the mucous membrane, its wasting, and the destruction of the sensitive papillary layer as evidenced by the loss of smell, and lastly the beneficial effects of the same remedies that are useful in lupus non exedens, all seem to indicate the existence of some close relationship between the two maladies.

Idiopathic ozæna sometimes commences during childhood, and in spite of treatment continues until after the middle period of life. When it has continued long, more or less alteration in the contour of the nose is sometimes observed: thus there may be more or less dilatation of the nostrils, and some flattening of the bridge of the nose. The sense of smell is permanently impaired, and sometimes altogether lost.

Treatment.—In the treatment of this form of ozæna the nasal douche is especially valuable. The solution used may be varied from time to time; in some cases one solution, in others a different solution answers best. Solutions of permanganate of potash, chlorinated soda, carbolic acid, etc., may be used to deodorize and cleanse away the discharges, and solutions of nitrate of silver, or bichloride of mercury, or sulphate of copper, or the ordinary mercurial lotions, may be used as so-called "alteratives;" and alum, sulphate of zinc, tannic acid, etc., as astringents. The strength of the solution must be varied according to the effects produced. Care must be taken that poisonous solutions are not swallowed. It is well to begin with weak solutions, and gradually increase their strength. The smarting produced should not continue for more than a minute or two after the washing has ceased. If it does, too strong a solution has been employed; or the specific gravity of the solution has not been properly regulated by the addition of the common salt or phosphate of soda. After the crusts and discharges have been washed away, iodine vapor may be advantageously inhaled for a few minutes. A little tincture of iodine may be added to hot water and the vapor inhaled; or the patient may "smell" a portion of solid iodine, or a sponge moistened with the tincture, contained in a small glass or wooden box perforated above and below. Chlorine and bromine inhalations may also be recommended.

In the treatment of this form of ozæna, Trousseau speaks most favorably of the insufflation of various powders. Among those most generally applicable are the subnitrate of bismuth combined with an equal proportion of talc; chlorate of potash by itself, or with seven or eight parts of sugar; borax, similarly diluted; the mercurial powders already alluded to; calomel, with twenty to thirty parts of talc, etc. The effects of the insufflation of the mercurial powders should be very carefully watched, and the insufflation should not be too frequently repeated. Two or three times a day is generally often enough. But the other powders may be used much more frequently, almost ad libitum. In all cases it is important to wash out the nose thoroughly before blowing in the powders. It not unfrequently happens that the thorough cleansing of the cavities, and subsequent insufflation of the powder, is followed by immediate abolition of the foul odor,—for the odor belongs to the discharge. But such abolition as a rule is only temporary. When the discharge collects

[1] The French name "Punaisie" is suggestive, but it fails to convey a full idea of the character of the stench.

again, the odor returns. In some cases the application of solid nitrate of silver to the various parts of the mucous membrane, so far as practicable, does good, although at the time it occasions much pain and lacrymation.

Wetzler[1] recommends the application of creasote ointment (ʒj to ℥j cerate) to the mucous membrane by means of a camel's-hair brush.

The special local treatment must be varied from time to time according to the indications that arise. Sometimes one application, sometimes another, seems to do most good. It is necessary to persevere for some time even after the discharge has ceased, or at any rate has lost to some extent its foulness. Relapses are very common; and the patient is too often apt to be encouraged by temporary improvement to discontinue the treatment, before the condition of the mucous membrane is so far modified as to render probable the permanence of the cure. The greatest patience is requisite in the management of these cases; and the most careful examination should be made from time to time, for it sometimes happens that some definite local origin may be discovered, although the case has been long considered to have depended upon constitutional causes.

[Iodoform, in powder alone, or with tannin, or in mass with gelatin (H. Allen), is often a valuable topical agent in the treatment. Its unpleasant odor may be sufficiently masked, in some instances, by the addition of some essential oil.]

Cod-liver oil, iodide of iron, iodide of ammonium in small doses, and sometimes arsenical preparations, are the internal remedies which have seemed to be most useful.

Glandular Hypertrophy of the Mucous Membrane.

Attention has recently been directed to a class of cases in which there is more or less swelling or thickening of the naso-pharyngeal and naso-palatine mucous membrane, associated with enlargement of the various glandular structures belonging to it.

In one group of cases[2] the racemose and compound follicular glands appear to be especially affected. These glands are most numerous about the posterior nares, round the openings of the Eustachian tubes, and in the roof of the pharynx under the petrosal bone. When they become morbidly affected, an excessive quantity of viscid mucus is secreted. At a later period pus-like fluid may be discharged. Still later the mucous or purulent secretion, if retained for some time, may become converted "into little fetid cheesy masses, which are from time to time extruded through the nose or mouth." Accompanying these conditions the mucous membrane generally is more or less irregularly swollen. The ordinary symptoms are, "discomfort, aching, or pain in the neighborhood of the soft palate and posterior nares; tingling or sense of fulness about the root of the nose; frontal headache; a thick mucous, purulent, or cheesy secretion discharged at intervals, chiefly through the mouth, by means of snorting nasal inspirations, followed by hawking; slight perversions of taste and smell; alterations of voice; sometimes temporary deafness from obstruction of one or both Eustachian tubes, and an abundant secretion of wax in the external ear."[1] In all cases presenting such symptoms, rhinoscopic inspection and digital exploration should be made.

The treatment is often tedious and sometimes unsatisfactory. The nasal douche is especially applicable in these cases. Mild astringent solutions are indicated. In some cases I have seen excellent results follow the application of a mixture of tincture of the perchloride of iron and honey (one part of the former to two of the latter), by means of a camel's-hair brush, to the surface of the naso-pharyngeal mucous membrane. In other cases a strong solution of nitrate of silver similarly applied, as recommended by Dr. A. Clark, has proved useful.

Attention should be directed to the general health, especially to the condition of the digestive organs, which are frequently disordered in these cases. Purgatives followed by tonics, are generally indicated, and sometimes cod-liver oil and steel [iron].

In another group of cases, especially described by Dr. Wilhelm Meyer of Copenhagen,[2] exuberant growths of vegetations are met with in certain parts of the naso-pharyngeal cavity. "These vegetations, when examined microscopically, are found to consist of the so-called 'adenoid tissue,'" and are accordingly to be regarded as overgrowths or morbid growths of the closed glandular structures found in or beneath the mucous membrane of the pharynx, the fauces, and the base of

[1] See Weber, in "Pitha und Billroth," op. cit.

[2] See Dr. Andrew Clark, "On Naso-palatine Gland Disease," London Hospital Reports, vol. i., p. 211.

[1] Dr. A. Clark, op. cit.

[2] Proceedings of the Royal Med.-Chir. Soc., October 18, 1869. "On Adenoid Vegetations in the Naso-pharyngeal Cavity," by Wilhelm Meyer, M.D., of Copenhagen. Communicated by John Marshall, F.R.S.

the tongue. They vary in form and consistency: sometimes they are solid and firm, and at others soft and highly vascular, and prone to bleed.

The presence of these vegetations in any considerable quantity impedes respiration through the nose, and gives a peculiar "nasal" character to the voice. There is often some degree of deafness. "The nostrils are flattened so that the nose appears compressed." There is deficient secretion from the nostrils, and sometimes blood accumulates in the mouth. Digital examination and rhinoscopic inspection demonstrate the presence of the outgrowths. They are most frequently met with in underfed young people. The treatment consists in removing the vegetations by the knife, or by the galvanic cautery, or by repeated applications of nitrate of silver. Dr. Meyer recommends the use of "a ring-shaped knife, mounted on a long slender handle, which is passed through one or other nostril, and manœuvred so as to sweep over the mucous surface affected. The bleeding is free, but not excessive." Two or more operations are sometimes necessary. According to Dr. Meyer, the results of this proceeding, supplemented by the use of the nasal douche, have proved very satisfactory.

[A pair of gouge-forceps properly curved forms an admirable instrument for cutting away these exuberant masses. As only abnormal tissue will come within their grasp, there need be little hesitation in freely sweeping the vault of the pharynx with them.]

Affections of the Septum.

Besides the deviations and deformities already alluded to (p. 226) the septum is liable to various affections, which from their practical importance merit more special description than has been given in the preceding pages.

These affections for the most part present themselves as swellings or tumors, possessing different characters; some contain blood, others pus, others a gelatinous fluid, and others again have a somewhat cartilaginous consistence.

Blood tumors of the septum are always the result of injury, and generally are formed within a few hours of the accident. The swelling usually occupies both sides of the septum, but it may be confined to one side. In some cases the mucous membrane only presents a flattened elevation, appearing as if raised by uniform effusion beneath it; in others it is more or less distended. There is often a good deal of tension and surrounding hardness, which render the detection of fluid difficult. The swelling may generally be seen by aid of the speculum, or by simply pressing up the tip of the nose, and so dilating the nares. It is generally of a dark purple color, and smooth and glossy in appearance. Its base is broad, with more or less abrupt limits. The symptoms are a sense of fulness and stuffing of the nose, with impediment to free respiration proportioned to the extent of the effusion.

Treatment.—The indications are to prevent if possible inflammation and suppuration, and to favor absorption. The application of cold externally, by means either of the small ice-bag, or of evaporating lotions, may often prove useful. Incisions are rarely necessary. Jarjavay cites an instance of loosening of the pituitary membrane of the septum caused by effused blood after a bruise. The swelling completely displaced the cavity of the nose on each side of the septum, and the patient could breathe only by the mouth. An incision was made into the swelling; dark liquid blood was discharged, and a breach of continuity in the septum was detected with a probe.

Abscess of the septum.—Abscess of the septum may result from injury. It is more likely to do so in the case of a scrofulous subject, or in one suffering from fever.[1] It often occurs when the integument is wounded near the lower edge of the nasal bones. In such case the integument of the nose becomes œdematous and tender on pressure; the pituitary membrane is inflamed, and the portion covering the septum is uniformly turgid; the secretion of mucus is diminished; and there is more or less febrile disturbance. At a later period matter is formed beneath the mucous membrane; and a prominent swelling, causing proportionate obstruction, appears in one nostril or both. The inflammation may spread to the frontal sinuses and lacrymal passages; and headache and epiphora may result. Sometimes the lower margin of the septum and the upper lip become affected. The swelling itself is red, shining, tender on pressure, and its base is extensive; fluctuation can be distinctly detected, and sometimes is communicated from one side to the other through the septum.

In the *treatment* of such cases it is important to prevent the formation of matter if possible, and if not, to give it free exit by incision as soon as it is formed. In making the incision the thickened state of the mucous membrane must be borne in

[1] See Mr. Fleming's able article in the Dublin Journal of Med. Sciences, vol. iv., pp. 16–28.

mind, and care must be taken to prevent the too early closure of the opening made. The discharge is generally of a thin sero-purulent nature at first, but by and by assumes a glairy consistency. Soothing, and subsequently astringent washes and injections are useful in restoring the mucous membrane to its normal condition.

Chronic abscess of the septum sometimes commences without any assignable cause, and progresses very insidiously. The inflammatory stage is sometimes so faint as to pass unheeded; and the patient is not aware that anything is the matter till the abscess is fully formed; and then suffers not so much from actual pain, as from uneasiness felt in the nares. In these cases the outer surface of the nose is never involved. In this form of abscess there is less redness, tension, and tenderness on pressure than in the acute form. The abscess, besides, is more extensive, and more likely to occur singly on either side of the septum. [It is sometimes found between the cartilaginous layers.] It may communicate with a collection of fluid situated outside the nose—in the upper lip, for example. The matter secreted has sometimes a highly offensive smell.

The swellings formed by such abscesses may possibly be mistaken for polypi, unless care is taken in the diagnosis. They are still more likely perhaps to be confounded with the thickened elongated condition sometimes presented by the mucous membrane of the septum.

These abscesses should be opened early; and in some cases benefit will be derived from injecting a weak solution of nitrate of silver or some detergent solution into the cavity. Every care must be taken to prevent extension of the disease, and to obtain a cure without any permanent deformity. A guarded prognosis should always be given in these, as in other affections of the septum; for there is always danger of the destruction of the bones or cartilages, or both; and this may take place long after the apparent cure of the malady. In the majority of cases, perforation, with more or less destruction of the cartilaginous septum, may be expected. Mr. Fleming states that this may be effected by interstitial absorption without ulceration of the mucous membrane, in which case the mucous membrane of one nostril adheres to the other; or ulceration may arise, and then an opening of variable extent admits of communication between them.

When a small permanent opening remains through the septum, a very disagreeable whistling is sometimes produced when the patient speaks. In one case under my cognizance in which this gave rise to great annoyance, the small opening was enlarged by incision. The result was very satisfactory.

[*Submucous infiltration of the septum.*—Rhinoscopic inspection often reveals a peculiar œdematoid appearance of the posterior portion of the septum, due to infiltration beneath the mucous membrane. It gives rise to the sensation of the presence of a foreign body, and to futile efforts at its dislodgment by hawking. It is frequently associated with chronic catarrh of the nasal mucous membrane; but sometimes exists independently, though probably due to the existence of catarrhal inflammation in the first instance. The peculiar position of this morbid mass is such as to render it very difficult of access. The most reliable treatment is its destruction by the galvano-caustic knife or plate, carefully introduced anteriorly. The position of the platinum terminal should be verified by rhinoscopic inspection, whenever practicable, before the incandescence is excited; otherwise there will be great risk of burning the healthy tissues, rather than the morbid ones.]

New Growths. Polypi.

Abnormal growths of various kinds are not infrequently met with in the nasal cavities. Many of them are commonly termed *polypi*. But it would probably be better to use this term in a somewhat more restricted sense than is at present customary. Some of these growths are benign in character, others are malignant, others again are of doubtful malignancy. They are specifically named, according to their nature and situation, and for the most part may be classified as follows: First, Papillary Growths. Secondly, Mucous, Gelatinous, or Vesicular Polypi. Thirdly, Fibrous Polypi growing from the lateral walls of the nasal cavities. Fourthly, Naso-pharyngeal Polypi—also fibrous, but growing from the base of the skull. Fifthly, Cartilaginous and Osseous Growths. Sixthly, Malignant Growths.

Papillary Growths.

Cases occasionally, though rarely, occur in which the nostrils are obstructed, or more or less completely blocked up, by papillary growths springing from the mucous membrane. Such growths bear a general resemblance to the papillomata of the mucous membranes of other parts, but so far as I have seen, the individual papillæ are acuminated. They are usually, if not invariably, met with in children or young people; and as a rule, they spring from those portions only of the mucous membrane which line the cartilages. They

may be present in one nostril or in both. They are accompanied by some discharge or running from the nose, and give rise to a variable degree of irritation, and disposition to pick the nose. Respiration is obstructed, and the voice affected to an extent proportionate to their development. Their presence may be readily recognized on inspection.

Such growths may be easily and effectually removed by means of scissors, forceps, the wire snare, or the galvanic cautery. After they have been removed, the affected nostril should be carefully cleansed by syringing, until all discharge has ceased.

Two cases of this kind have recently come under my observation. Another is mentioned by Mr. Bryant,[1] and the particulars of several more have come to my knowledge. In all the treatment has been successful, and in none, so far as I know, has there been any recurrence of the growths.

Mucous, Gelatinous, or Vesicular Polypi.

These so-called "polypi," are by far the most common of all the abnormal growths met with in the nasal cavities. They may be regarded as localized hypertrophies, or outgrowths of the mucous membrane and submucous tissue. They are soft, pulpy, and somewhat elastic in consistence; pale, yellowish, grayish, or slightly greenish in color; and shining and semi-translucent in appearance. They are, as a rule, pedunculated and pendulous, and may be more or less easily moved by the finger or a probe. Sometimes they are moved to some extent to and fro during respiration, or they may be so moved by forcible respiratory efforts. In some cases they occur singly, in others they are multiple. Sometimes they are uniform in contour, and more or less pear-shaped. Sometimes they are irregularly lobulated, and fit themselves to the cavities in which they lie. When incised, and submitted to pressure, they give out a variable quantity of sero-albuminous or synovia-like fluid. Superficially, they are often seen to be traversed by a few fine bloodvessels.

Microscopical examination shows that these polypi are related to the "myxomatous" tumours of Virchow, among which indeed, they are sometimes included. They consist of extensions of the mucous membrane, including more or less closely reticulated fibro-cellular structure, which is continuous with the normal sub-mucous tissue. Their surface is covered by ciliated epithelium; and their substance is made up of delicate, wavy, interlacing filaments, the interstices of which are occupied by fluid, or semifluid material, containing round, oval, elongated, or caudate cells with nuclei, and very fine granules or molecules. The normal mucous glands, according to Billroth,[1] are enlarged and converted into clustering formations with very numerous sacculi, and these help to make up the mass. In some cases, these sacculi become cystic in appearance, and the "vesicular" character of the polypi is pronounced. In other cases the connective tissue elements are developed in larger proportion; and the growths are consequently firmer and denser, and approach in character the fibrous or sarcomatous polypi. Occasionally the softer polypi become comparatively condensed and opaque in places; and in some rare instances concretions of fibro-cartilaginous hardness are found in them.[2]

These polypi are most frequently connected with those portions of the mucous membrane which cover the superior and middle turbinated bones, and line the superior and middle meatuses. Sometimes they arise in the lower meatus, or are attached to the inferior turbinated bone; sometimes they spring from the roof of the nose; occasionally they grow from the ethmoidal cells, or even from the frontal sinuses into the nasal cavities. But they very rarely, if ever, spring from the mucous membrane covering the septum.[3] The relation which they may bear to the so-called adenoid vegetations growing from the naso-palatine mucous membrane or floor of the nose,[4] is by no means clearly made out; but it is by no means improbable that some such relationship exists. Both forms of growth appear to depend upon, or at any rate to be associated with, distension of the mucous follicles. It is not improbable that the serous infiltration, and somewhat dropsical appearance of the pendulous mucous polypi, as well as the elongation and slenderness of their pedicles, may be due to some extent to the fact that they grow from above downwards. On the other hand the broad bases, and comparative freedom from infiltration, of the sessile growths from the floor of the nose, accord with their situation and the direction in which they have to grow. Thus the effects of gravitation may help to explain

[1] Lancet, August, 1867, p. 225.

[1] See Weber, in "Pitha und Billroth," op. cit., p. 203. Billroth, Ueber den Bau der Schleimpolypen. Berlin, 1855.

[2] See case referred to by Gross, op. cit., vol. ii., p. 371, 5th ed. 1872.

[3] I have not been able to find a single satisfactory example on record.

[4] See p. 243.

in some degree the more obvious differences presented by these two forms of growth. Other differences may depend upon the special characters of the mucous follicles in different parts of the nasal cavities. It is worthy of note that the "adenoid vegetations" and sessile growths of the floor of the nose, most commonly occur in strumous children, while the mucous polypi of the upper cavities are most frequently met with in adults, although they may commence at a comparatively early age.[1]

In cases in which there are several distinct polypi, the lowest or most anterior, having the open nostril before them, make their way downwards uncompressed; but the others are kept up and hidden from sight, and become more or less compressed and hindered in their growth. The polypi, if uninterfered with, go on gradually increasing in size until they more or less completely fill up the nasal fossæ. Sometimes they have an especial tendency forwards, sometimes backwards; sometimes they hang down behind the uvula into the pharynx; sometimes they project forwards and expand the alar cartilages, and even, in rare instances, the nasal processes of the superior maxillary bones.[2] It is very seldom, however, that any of the bones are seriously affected, but they may sometimes be deprived of their investing membrane, and necrosis may consequently ensue. In the case of a lady, thirty-eight years of age, who had suffered from mucous polypus for many years, Mr. Ure[3] found "the internal osseous structure quite denuded." The patient was eventually cured, after extirpation of the growths.

The earliest symptoms of mucous polypus in the nose are a sense of fulness and weight in and about the nostril affected; frequent sneezing; and more or less mucous discharge. For a long time before the growth becomes visible, the patient seems to be always "catching cold." As the growth increases, other symptoms supervene: respiration through the nose becomes more and more embarrassed; the patient suffers from "stuffiness" and general discomfort; he cannot blow through the affected nostril, or the air passes with a whistling noise; he is obliged to keep his mouth constantly open; during sleep he lies with his head thrown back and often snores; the voice is more or less affected, and becomes thick, indistinct, and "nasal" in character; the sense of smell is impaired, or altogether abolished; the sense of taste is affected in so far as it is dependent upon the perfect condition of the olfactory organs; deafness sometimes occurs, either from obstruction to the Eustachian tubes, or from coexistent thickening of the lining membrane of the tympanum; there is more or less constant flow of thin or thick mucous discharge, and the patient is unable to "blow his nose" satisfactorily. The discharge is rarely offensive. Occasionally there is epistaxis, but not often. It is far otherwise in the case of fibrous polypi and malignant growths. Sometimes the lower orifice of the nasal duct becomes obstructed, and there is overflow of tears. These various symptoms become aggravated in damp, and somewhat alleviated in dry weather; for the polypi are "hygrometric" in character, and are notably affected by the state of the atmosphere. In dry, warm weather they contract; and in moist or wet weather they enlarge, and become fuller, and paler in color. Sudden atmospheric changes are liable to give rise to severe fits of sneezing.

[Manifestations of asthma are not infrequently kept up by reflex influence from impediment to nasal respiration due to the presence of polypi or to similar mechanical obstruction.]

The patient is often conscious of the presence of some fleshy substance, and makes frequent but ineffectual efforts to dislodge it, by blowing his nose, or introducing his fingers.

The symptoms thus detailed indicate the probable existence of mucous polypi. Inspection, conducted in the manner already described,[1] generally reveals their presence, and digital exploration may aid the diagnosis. When a good light is thrown into the well dilated nostril, the growth or growths may, as a rule, be readily recognized, and a probe may be passed round the lower parts and carried upwards to some height on either side. Sometimes the growths come more into view after the patient has attempted to blow forcibly through the affected nostril; or they may be pushed into more favorable position by introducing the finger round the free margin of the soft palate into the posterior nares. *Posterior rhinoscopy* is sometimes necessary, or at any rate desirable.

When the polypi can be thus seen and felt, the diagnosis is sufficiently easy. But in the earlier stages it is often difficult and sometimes impossible to get a view of the growths, or to reach them with the fingers. Under such circumstances, the case, if it should come under the observation of the surgeon, may for some time be supposed to be one of chronic

[1] See Weber, in "Pitha und Billroth," op. cit.

[2] Weber, op. cit.

[3] First edition of this work, vol. iii., p. 212.

[1] See Rhinoscopy, p. 226 et seq.

catarrh, and the discharge to be a simple coryza. In the more advanced stages no such difficulty is likely to exist, if only a careful examination is made. It is well, however, to bear in mind that hypertrophy of the mucous membrane of the inferior turbinated bone, displacement of the septum, abscess of the septum, and foreign bodies, have all been mistaken for mucous polypi, and grievous errors in treatment have resulted.

I have recently had under my care a gentleman who had been treated for "ozæna" for two years. Both sides of his nose were stuffed full of polypi. Another case has come to my knowledge, in which a great part of the inferior turbinated bone was removed in mistake for a polypus. Mr. Ure mentions a case in which "an inexperienced practitioner, believing he had to do with a polypus in a young lady, tore away a portion of the membrane (covering the septum), and laid bare the bone."

It is not always easy, however, to ascertain the exact attachment of the polypus, nor to make out at first whether the growth is single or multiple. But these are points of little practical importance. It may sometimes be difficult, but it is always important, to distinguish the benign mucous polypus from other growths of more serious nature. The light color, semi-translucency, and soft elasticity of the mucous polypus, its slow progress, the absence of frequent hemorrhages, and the general good health of the patient, serve to distinguish this growth from the fibrous polypus, which is more or less red in color, opaque and resistant, and which usually increases rapidly, undergoes no change of volume with change of weather, and is usually accompanied by frequent epistaxis. Malignant growths may be distinguished by their color, opacity, consistence, and fixity, as well as by their proneness to bleed when touched, and by the comparative foulness of the discharge to which they give rise. Osseous and cartilaginous growths are distinguished by their hardness, fixity, origin, and mode of growth.

Mucous polypi are always very troublesome, but rarely lead to serious results. Now and then they subside, and a spontaneous cure is effected. But it is never worth while to await such a result; for the growths may almost always be removed without much pain, and with scarcely any risk. They are, however, very liable to grow again, especially if any portions are left unremoved, or the patient is unwilling to persevere in the necessary course of treatment.

Treatment.—The only treatment that can be recommended essentially consists in the removal of the growths by operation as completely as possible.

Attempts have been made from time to time to obviate the necessity for operative measures by the use of various escharotic, astringent, and exsiccative applications. But the general results of such attempts have not hitherto been satisfactory, although doubtless, in some instances, much good has been effected. Alum, calomel, oxysulphuret of antimony with sugar, cinchona bark, and many other substances in powder, have been used as snuffs, and different astringent solutions have been injected from time immemorial. "At one time," according to Professor Gross, "a good deal of reliance was placed upon the use of finely pulverized blood-root as a snuff; and in 1859, Dr. J. H. Reeder of Illinois published the particulars of two cases in which prompt cures were obtained by strong injections of the tincture of perchloride of iron, aided by the application of a piece of sponge moistened with a solution of this article to the cavity of the nose."[1] Mr. Erichsen refers to a case in which "after the assiduous use of chloride of zinc injections, a very copious discharge of large sloughy polypoid masses took place from one nostril, which had been blocked up for many months previously."[2] Nélaton recommends in some cases the repeated application of solid nitrate of silver.[3] Mr. Bryant has recently advocated the insufflation of tannic acid in powder.[4] The use of bichromate of potash in a similar manner has been suggested, on the ground probably of the special influence which this salt is believed to exert on the nasal mucous membrane.[5] Cases illustrative of its good effects have been published, but at present it has not been extensively tried.

Various methods have been devised for the removal of nasal polypi by operation. In judging which it is best to adopt, the peculiarities of the case under treatment must be taken into consideration. It is always desirable, however, that the surgeon should obtain as good a view as pos-

[1] Op. cit., vol. ii., p. 373.

[2] Science and Art of Surgery, Am. ed., 1878, p. 386.

[3] Pathologie chirurgicale, tome ii., p. 679.

[4] Lancet, February, 1867, p. 235.

[5] According to MM. Becourt and Chevallier, workmen employed in the manufacture of bichromate of potash suffer in a remarkable manner from the effects of the small particles of the salt which they are liable to inhale. The mucous membrane of the nose is seriously affected. Excessive irritation, coryza, and sternutation, are the earliest symptoms. The mucous membrane becomes thinned; detached portions of it come away; after six or eight days the bony septum itself becomes thin, and at last is gradually destroyed.—Annales d'Hygiène, July, 1863, p. 83; quoted in Sydenham Society's Year Book, 1863, p. 457.

sible of the parts upon which he is operating. The patient must therefore be placed in proper position opposite a good light, or arrangements must be made in accordance with the directions already given for rhinoscopy. The reflector and speculum afford invaluable aid during the operation. Chloroform is rarely necessary; and if not necessary its administration is undesirable, because by it the patient is rendered unable to assist the surgeon by blowing the polypi downwards and forwards, and clearing the passages from blood. There is, moreover, a possible risk of blood passing into the windpipe.

The method at present most commonly adopted consists in the avulsion of the growths by means of forceps. The forceps should be about seven or eight inches in length, and strong, but as slender as may be consistent with strength. The ordinary forceps are too thick. The blades should be grooved longitudinally, and well serrated along their edges. They may be curved or straight. Curved forceps are required when the polypi are situated far back, and have to be removed through the mouth. In most cases in which it is intended to remove the growths through the nostrils, straight or nearly straight forceps are best. The patient should be seated on a rather high chair; his head should be thrown well back, and supported by an assistant, who at the same time may advantageously elevate the tip of the nose, and hold the speculum by which the nostril is dilated. The elevation of the tip of the nose is especially desirable in cases in which it is requisite to introduce a straight instrument into the lower meatus, for, as already hinted, the external opening of the nostril is on a somewhat lower level than the floor of the nasal cavity. The closed blades of the forceps are introduced into the nose, and made to glide along the floor or septum until their extremities have reached, and passed to some extent the visible portion of the polypus. The blades are then opened in a vertical or oblique direction, and turned upwards and outwards, so as to include between them as much as possible of the growth. The growth is seized and held as tightly as possible, and is finally torn from its attachment, and removed from the nose by steady traction, and rotation of the forceps on their long axis. It is better as far as possible to twist the polypus off, as it were, rather than to drag it straight away at once.

Sometimes the polypus yields, and is pulled out of the nostril without being detached from the general mucous membrane. In such cases, it must be grasped close to its root by means of a second pair of forceps, and twisted and pulled until its entire avulsion is accomplished; or its pedicle, if within reach, may be divided by scissors or a bistoury.

When the polypus is situated far back and hangs down into the pharynx, it may sometimes be seized and removed by means of properly curved forceps introduced through the mouth. There is often, however, great difficulty in keeping the tongue down, and in resisting the spasmodic retching which is apt to be excited by the presence of the instrument. Moreover, it is not always easy to avoid including the mucous membrane of the uvula or soft palate between the blades of the forceps. The better plan, therefore, would seem to be, as suggested by Mr. Syme,[1] to detach the polypus by means of forceps introduced through the nostril, and then to push it on into the throat. In some cases, advantage may be derived from the use of forceps so constructed that the blades can be introduced separately, and afterwards locked together, after the manner of midwifery forceps.[2]

It is scarcely necessary to add that very great care must be exercised in applying the forceps and removing the growths. Otherwise there is considerable risk of inflicting more or less serious damage. Many instances have occurred in which one or other of the turbinated bones, as well as large portions of mucous membrane and periosteum, have been ruthlessly torn away.

But although the method of extraction by forceps thus described is recommended by most surgical writers, and very generally adopted, I believe it is far inferior, in many respects, to the method of extraction by the "wire snare" devised by Mr. Hilton. This method has been for many years past constantly and successfully practised at Guy's Hospital, to the almost entire exclusion of the use of the forceps. But it does not appear to be so widely known as it deserves to be. In our experience it has proved more easy and effectual, and less painful and less likely to prove mischievous, than other methods commonly adopted.

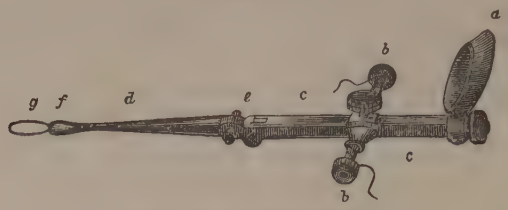
The instrument employed is figured on the next page (Fig. 300). The thumb of the surgeon is passed into the ring *a*; his middle and forefinger hold the cross-piece *b*, and slide it backwards and forwards along the quadrangular stem *c*. The nasal portion *d* of the instrument is cylindrical, slender, and tapering. It is connected with the quadrangular portion *c*, by means of a hinge joint *e*, so that it may be bent at such an angle as to enable the hand of the operator to be kept

[1] Principles of Surgery, p. 476.

[2] Schreger, Neuer Chiron, vol. i., part ii., p. 197. Quoted in South's "Chelius," vol. ii., p. 732.

from obstructing the view. Its slightly bulbous extremity *f* is doubly perforated in a longitudinal direction for the passage of the wire. The wire is connected on either side with the sliding cross-piece *b*, and forms a loop *g* beyond the bulbous extremity *f*, after having traversed its perforations. In its course the wire passes through two small holes in little wing-like processes close to the joint *e*, so

Fig. 300.



Hilton's nasal polypus snare.

that it may be kept in proper position at whatever angle the instrument may be bent. The wire I have found to answer best consists of two or three filaments of very fine annealed steel wire smoothly twisted together. Silvered copper wire is commonly used, but this bends too easily, and is apt to kink and break. Fishing gimp and salmon line gut are strong enough, and do not kink; but they are too limp to be pushed beyond the growth, if it is close to the floor or septum of the nose. Whatever material is used, it should be so proportioned in thickness as to run easily through the several holes of the instrument; and the edges of these should be so rounded as not to catch or cut the wire.

The manner of using this instrument is sufficiently obvious. The cross-piece is advanced as far as possible, and a good-sized loop of wire, much larger than that represented in the figure, is projected beyond the distal extremity of the instrument. This loop is introduced into the nostril with as much of the slender portion of the instrument as may be necessary, and the growth is encircled by moving the wire in the proper direction. The cross-piece is next drawn home and firmly held. The growth thus securely noosed, is then twisted and pulled from its attachment without difficulty, and with little or no risk of damage to the subjacent bone. In cases in which the attachment of the growth is high up, the wire loop may be directed into position by means of a very small blunt fork mounted on a long slender stem; and in cases in which the growth is situated very far back, the wire may be made to encircle it by aid of the finger passed through the mouth and round the posterior border of the soft palate. Portions of the mucous membrane adjoining the base of the pedicle of the polypus are sometimes brought away, but this is of little or no moment. It is obvious that with the wire snare it is impossible to inflict such damage to the bones as has too often resulted from the incautious use of the forceps. In the case of any broad-based swelling, such as that of hypertrophied mucous membrane or septal abscess, the wire necessarily slips over the surface, and cannot, like the forceps, seize that which it would be undesirable or detrimental to tear away. If the pedicle of the polypi should be very thick, it may be advisable to use the wire rope écraseur, with screw movement, instead of the snare just described.

[This snare, mounted upon a rectangular handle, like the aural snare, is often much more conveniently manipulated, the hand of the operator being far less likely to obscure vision of the distal portion of the instrument. An ingenious wire snare working through a delicate canula, and tightened by turning the milled head of a screw, which separates an inner tube from its sheath, has been devised by Dr. W. C. Jarvis, of New York.[1] The delicacy of the canula is such as to render the instrument available in very narrow passages, where coarser instruments are altogether inadmissible.]

In some instances polypi may be successfully removed by the fingers alone. One forefinger is thrust into the affected nostril, and the other is introduced into the posterior nares through the mouth. When the growth is reached, and held between the two fingers, it is pushed backwards and forwards until all resistance has ceased, and it is then withdrawn through the nearest opening. Morand and Sabatier succeeded thus;[2] and Gross in a similar manner "promptly removed a large gelatinoid polypus from a youth of seventeen." In this case "the tumor had a very narrow footstalk attached to the posterior extremity of the inferior spongy

[1] Medical Record, April 30, 1881.]

[2] First edition of this work, vol. iii., p. 215.

bone, which was therefore easily torn asunder."[1] But this method, though apparently simple, is rarely practicable, for reasons which are sufficiently obvious.

Dr. M'Ruer, an American physician, advocates the following method: A piece of catgut is to be passed through the nostril into the mouth, and to its extremity is to be "fastened a piece of soft, dry sponge, corresponding in size, when firmly compressed, to the narrowest part of the nasal passage." The sponge is then to be drawn gently forward through the posterior nares, and through the nose. Dr. M'Ruer "thus succeeded in at least ten cases in bringing away all the adventitious growths."[2] This method has an appearance of clumsiness which scarcely recommends it to general adoption.

In the case of large polypi, situated far back, it may sometimes be advantageous to make a button-hole-like opening through the soft palate—the "boutonnière palatine," of M. Maissonneuve.[3] The direction of the incision should be from before backwards; and it should be made in the median line. The great elasticity of the parts composing the soft palate permits a polypus of large size to be drawn through a comparatively small opening; and the same elasticity aids the subsequent closure of the wound. The polypus drawn through the opening may be cut or twisted off, or ligatured with comparative ease. After this has been done, the wound may be either left to itself, or closed by one or two sutures. So far back as the year 1747, Manne, a surgeon of Avignon, slit the soft palate in a difficult case, and at different times removed portions of the growth. He then introduced into the remaining portion several threads, by means of which he drew the polypus forwards. His fingers passed through the mouth pushed it in the same direction. The pedicle ruptured, and the tumor was withdrawn through the nostril, with a noise "which resembled the uncorking of a bottle." A second polypus which subsequently showed itself was similarly extracted, and the cure was complete.[4]

Whichever of the methods thus described be adopted, the operation is liable to be attended by more or less hemorrhage, which sometimes may be very troublesome, or at any rate may impede the proceedings of the surgeon. As a general rule, however, the bleeding soon ceases spontaneously, or may be easily arrested by the injection of cold [or hot] water or astringent solutions. In some rare instances, however, it may be necessary to plug the nares. In every case, if there is much bleeding, and especially if the patient has suffered severely, it is better to defer the completion of the operation to a future period. And thus it often becomes advisable to operate on several successive occasions, and to remove the growths piecemeal, rather than to overtax the endurance of the patient by attempting too much at a single sitting.

Dr. Thudichum has recently very strongly advocated the use of the galvano-caustic wire for the removal of nasal polypi, especially with a view to avoid the risk of hemorrhage; and because this method, in his opinion, is attended by comparatively little pain. The apparatus which he uses consists of a modification of Middledorpf's platinum wire carrier, connected with a battery of five large Grove's cells. The growth is encircled by the loop of wire, which is tightened by screwing up the windlass. Connection is then made, and the portion of the growth included in the noose is quickly burnt off, and withdrawn through the nostril.[1] The advantages of this method when practicable are manifest. Its disadvantages are that it involves the use of apparatus troublesome to prepare, not commonly in the armamentarium of the surgeon, and formidable in appearance to the patient; and that by it the growths are removed by a tedious piecemeal process. In one case, for example, detailed by Dr. Thudichum, the polypi were removed from one nostril in no less than fifty-five different portions; and in another case thirty-three introductions of the loop were necessary. It is obvious that only the portion included by the heated loop is cut off; whereas by the use of the wire snare (p. 250), or the forceps, a great deal more than that which the wire includes or the forceps grasp, is at once removed; indeed, a comparatively small hold suffices for the extraction of a very large and extensively lobulated growth. Nevertheless, it cannot be disputed that in some cases Dr. Thudichum's plan is of the greatest practical value.

After any operation for the removal of nasal polypi, whether incomplete or apparently complete, it is well to wash out the nose regularly during some considerable period with astringent or detergent solutions, by means of the nasal douche or syringe. And in some cases the insufflation of tannic acid or other powders proves of great service, either in hindering the development of fresh growths, or in aiding the destruction of such portions

[1] Op. cit., vol. ii., p. 342.

[2] First edition of this work, vol. iii., p. 217.

[3] Comptes-rendus, août, 1859. Ranking's Half-Yearly Abstract, 1859, p. 196.

[4] H. Cloquet, Ophrésiologie, p. 668.

[1] Op. cit., p. 9.

as may have had their vitality impaired by the operation. It often happens that, after a partially satisfactory operation, large portions of growth may be thus got rid of and washed away; and the cure may be accomplished, or the patient may be enabled to go on in comfort for a considerable period.

The extirpation of mucous polypi by means of the ligature, merits no discussion in these pages.[1] The method is condemned alike by reason and experience. There is scarcely any region of the body in which the presence of a sloughing mass is more objectionable than in the nasal cavities. The operation itself is not easy; and the effects are disagreeable in the extreme, even if not dangerous. Moreover, it is obvious that any growth of this kind which can be included in the ligature, may with equal ease be included and cut off at once by the wire-rope écraseur or by the galvano-caustic wire.

Fibrous Polypi.

Fibrous polypi are by no means so commonly met with in the nasal cavities as the softer growths described in the preceding pages, but they are far more formidable. If allowed to take their course, they give rise to the most serious results. Their extirpation is often very difficult, and sometimes impracticable; and, moreover, the operative measures requisite may be attended by considerable risk.

These growths spring from the periosteum, and are connected with it by continuity of structure. They are covered by an extension of the mucous membrane, sometimes comparatively thick, but more frequently thinned away. As a rule they occur singly, but in some rare instances two or more distinct growths have been found.[2] They vary much in shape and size, according to the degree of development they may have attained, and the direction in which they may have grown. Sometimes they are uniform in contour, and more or less globular or pear-shaped. But as a rule they are elongated and very irregular in shape, presenting finger-like prolongations, rounded out-growths, or broad-based lobules in those parts which have encountered least resistance. They are firm and resistant to the touch, and are sometimes of almost cartilaginous hardness. They have nothing of the yielding "oyster-like" softness of the mucous polypi. They are opaque. While growing they are usually more or less red in color—in some cases comparatively pale, in others dark or even purplish-red. When removed from the body, they are generally dull-white, or yellowish. But the tint varies in different specimens, and in different parts of the same specimen. They are traversed, not only superficially, but also throughout their substance, by numerous thin-walled blood-vessels, which are sometimes varicose. Hence their proneness to bleed. They cut somewhat crisply, and on section present a more or less uneven, and occasionally almost mammillated surface. They are composed, for the most part, of closely-woven-strands of white fibrous tissue, which spread out from the pedicle. They contain very few elastic fibres. In different specimens a variable proportion of spindle-shaped nucleated cells, similar to those of sarcomatous growths, are to be found. Sometimes these are so numerous, and the general appearances are such, as to indicate that the growth must be considered "fibroid" rather than "fibrous," and that it approaches in character the more malignant forms of new growth.

Instances are on record in which deposits of carbonate and phosphate of lime have taken place on the surface of these growths,[1] as well as others in which the growths themselves have undergone a process of partial calcification.[2]

Fibrous polypi occasionally spring from the periosteum of the lateral walls of the nasal cavities or pterygo-palatine fossæ, and somewhat more frequently, perhaps, from the floor of the nose.

In some instances they appear to have originated in the antrum, and to have extended from thence into the nose. But in many cases, in which they have been supposed to have taken such a course, further investigation has shown their origin to have been very different.[3]

There can be no doubt, however, that polypi of the kind under discussion most frequently take origin from the periosteum of those portions of the base of the skull

[1] The method of applying the ligature by means of the double canula is described by Sir Wm. Fergusson in his treatise on Operative Surgery, 3d edit., p. 580. But, though he describes, he does not commend the operation.

[2] MM. Lallemand and Cruveilhier record the case of a young man in whom were found on post-mortem examination two polypi of the kind under discussion. One grew from the posterior part of the superior turbinated bone and adjoining parts on the left side, the other from below the opening of the sphenoidal sinus on the right side.—Dict. en. 60 vol.

[1] H. Cloquet, op. cit., p. 688.

[2] Bourdillat, Gazette médicale, 1868; "Fibrome calcifié."

[3] This was notably the case in the very remarkable instance narrated by Mr. Prescott Hewett, in the Med.-Chir. Trans., vol. xxxiv. [See DISEASES OF THE MOUTH.]

which form the roof of the naso-pharyngeal cavity. In such case they are "naso-pharyngeal polypi" properly so called, and as such are described in the next section. But it is often very difficult, and sometimes indeed impossible to determine the precise point of origin of a fibrous polypus until the nasal cavities have been fully exposed to view by operation.[1] The difficulty is increased by the tendency which these growths have to acquire secondary attachments. Such secondary attachments probably result from adhesion taking place between the opposed surfaces rendered bare by ulceration from pressure. In the case of a little child, under the care of M. Marjolin, it was found on post-mortem examination that, though the growth evidently sprang from the basilar process and body of the sphenoid, yet it spread along the septum and had numerous adhesions to different parts of the pituitary membrane, and especially to the posterior surface of the soft palate.[2]

Whatever their origin, these polypi increase in size with comparative rapidity. At first they mould themselves somewhat to the cavities in which they lie, and grow forwards, or backwards and downwards, in the direction of least resistance. When more advanced, they exert injurious pressure from within upon the walls of the nasal cavities, and in a certain sense overcome the resistance they encounter. They are liable to cause ulceration and destruction of the mucous membrane, perforation of the septum, and expansion and displacement of the nasal bones, and superior maxillæ; or gradual thinning and absorption of these bones may result from the pressure to which they are subject. The palate is pressed downwards and forwards; and the cavity of the mouth is encroached upon. In all such cases the visage is proportionately distorted. The cheeks become more or less prominent, and the nose expanded and flattened. The eyes appear, or actually are, more widely apart than natural. The general aspect thus produced is very characteristic. It has been not inappropriately termed "frog face." In some cases the distortion is symmetrical. In others, one side is more obviously distorted than the other. If one side only of the face is affected, the other remaining perfectly natural, the presumption is that the disease, whatever it may be, is in the antrum rather than in the nose, although the cavities of the latter may be encroached upon.

In the earlier stages the symptoms are similar to those produced by the mucous polypi, and it may be difficult to make the diagnosis. But the fibrous growths are firmer and more fixed than the mucous, and they do not undergo any change of volume under different atmospheric conditions. The symptoms therefore are more severe and more constant, and when the nose is once blocked, the obstruction to respiration is more absolute and unyielding. Moreover, the fibrous polypi give rise to frequently recurring epistaxis. This is not only a very characteristic symptom, but it may prove the source of much anxiety and danger. The discharge from the nose associated with the presence of a fibrous polypus is as a rule more scanty, and thinner, more sanious, and more liable to become foul and ozænic than the mucous discharge usually associated with the presence of the softer growths.

In the latter stages, when the polypus can be distinctly seen and felt by the surgeon, and still further when from its size it has caused distortion of the face, there can be little or no difficulty in making out the nature of the growth, whatever doubt there may remain as to its precise origin and connections. Careful exploration, and pressure in different directions alternately by the fingers, and the passage of a bent probe round the free parts of the polypus, first on one side, then on the other, may often afford reliable indications of the probable position of the original pedicle, as well as of such secondary attachments as may have been formed. If any question should arise as to the possible malignant nature of the growth under examination, conclusive evidence may be obtained by microscopical examination of a small portion removed by means of a grooved needle or fine trocar or canula.

Treatment.—The treatment requisite consists in the complete extirpation of the growth by operation. Medicinal treatment is of no service whatever, except in supporting the general health and strength under the depressing influence of the loss of blood and general suffering occasioned by the growth. Local applications are worse than useless; they may stimulate and irritate, but they can neither arrest nor destroy the growth.

The method of extirpation that it is best to adopt depends upon the size of the growth, and the situation of its pedicle. If the growth is not large, and its point of origin is neither very far back nor very high up, and if, also, its pedicle can be reached and is not too broad, it

[1] In a case described by M. Gerdy, a polypus growing from one side, perforated the septum, and appeared on the other side, and thus gave rise to the opinion that two polypi were present.—Nélaton, op. cit.

[2] Gazette des Hôpitaux, May 25, 1861.

may be removed through the nostril or posterior nares, like the mucous polypus, by means of the wire snare, the écraseur, or the galvano-caustic wire; or if it should be deemed desirable, a ligature may be applied, and the growth may be allowed to slough off; but I cannot forbear repeating that this method of treatment is open to serious objection, and is not free from danger. It may, however, be justifiable in certain exceptional cases. One fatal instance has come to my knowledge; and in that instance, even if the patient had survived, the operation would have been only partially successful, for it was a comparatively small portion of the growth only that had been included in the ligature.

In cases in which the growth is large, or in which its point of origin cannot be determined, or is situated very high up or far back, resort must be had to one or other of the operations described in the next section, on naso-pharyngeal polypi.

Naso-pharyngeal Polypi.

The growths so named are, as already intimated, fibrous polypi growing from those portions of the base of the skull which form the roof of the naso-pharyngeal cavity, or rather from the periosteum which covers them. The periosteum of the basilar process of the occipital bone, the body of the sphenoid bone, and the immediately adjoining parts, is peculiarly thick and vascular. Its blood supply is very free, and derived from several different sources. Hence, perhaps, its liability to give origin to new growths, and the rapidity with which such growths often increase in size.

The naso-pharyngeal polypi, properly so called, invariably spring from some part or other of the limited area thus indicated. They are, however, prone to acquire secondary attachments, and thus may arise various sources of difficulty in arriving at a satisfactory conclusion as to their point of origin. Sometimes they become adherent to the walls of the nose, and consequently may be supposed to be nasal polypi. Occasionally they extend down behind the pharynx, and in such case may appear to have arisen from the anterior surface of the spinal column.[1]

[1] These several points are ably discussed in the Treatise of Dr. Robin Massé, Des Polypes naso-pharyngiens, Paris, 1864; and also in the elaborate essay of M. d'Ornellas, Des Polypes fibreux de la base du Crâne, dits naso-pharyngiens; Paris, 1854. And in the essay by M. Beuf on the same subject; Paris, 1857. Also by M. Brevet, Des Polypes naso-pharyngiens; Paris, 1855.

In structure these growths differ in no respect from the fibrous polypi of the nose already described (p. 252); and it must be borne in mind that polypi, whether fibrous or mucous, which arise from the nasal parietes, may extend into the pharynx as well as along the cavities of the nose, and thus may become, in a certain sense, naso-pharyngeal. But the growths now under discussion are distinguished by their origin, by the rapidity of their growth, by the remarkable manner in which they invade the various neighboring cavities, and by the very serious results to which they may give rise.

During the earliest stages of the growth of a naso-pharyngeal polypus, the only obvious system is frequent epistaxis. The blood may pass from the nostrils, or may enter the pharynx and be ejected from the mouth. Frequent epistaxis from both nostrils must always be regarded as a suspicious symptom, and one indicating the necessity for careful examination. As the growth increases in size, respiration through the nose becomes generally more and more impeded, and the patient suffers from a sense of "stuffiness." At this period rhinoscopic examination at once reveals the existence of the growth; and on digital exploration it may be felt as a rounded, hard, resistant tumor. If left to pursue its course, it soon presses upon the soft palate, and thus interferes with easy deglutition, and gives rise to frequent inclination to vomit. Sometimes, when attempts are made to swallow, liquid portions return through the nose. As the malady advances, thin, sanious, or purulent, and sometimes fetid discharges begin to flow more or less abundantly from the nostrils, and the epistaxis becomes more frequent and more severe. The growth generally enters one side of the nose first, and then invades the other, either by penetrating the septum or by growing round its posterior border. Still later, the spongy bones and septum become more or less extensively destroyed, in consequence of the pressure of the growth. The nasal bones and superior maxillæ also become destroyed to a variable extent, or expanded and pushed to either side; and the countenance is consequently distorted. Sometimes the growth enters the maxillary sinus, and presses upon the floor of the orbit; sometimes it seems to pass round the bone (or through it), and issues under the skin of the cheek, passing along the cutaneous aspect of the bone, and pressing together the walls of the antrum.[1] Sometimes the growth sends off prolongations through the spheno-palatine and

[1] See the remarkable case published by Mr. Prescott Hewett, already referred to; Med.-Chir. Trans., vol. xxxiv.

spheno-maxillary openings, and even extends under the zygomatic arch into the temporal fossa. MM. Maisonneuve and Chassaignac record cases in which growths of this kind had penetrated the pterygo-maxillary fissure, and passed through the pterygoidean space between the muscles towards the face.[1] In other cases extensions are sent into the frontal and sphenoidal sinuses. And in others, again, prolongations may pass through the spheno-maxillary fissure into the orbit, with or without destruction of bone, and so cause protrusion of the eyeball.[2] As a further consequence, the optic nerve may be put on the stretch, and vision may be impaired. Very frequently the orifices of the Eustachian tubes are obstructed, and the sense of hearing is dulled. Very frequently also, the nasal ducts are compressed, and more or less constant epiphora results. But the most serious consequences follow, when, as occasionally happens, the growth penetrates to the interior of the skull. In such case no treatment is of any avail. The growth may enter the skull either through the sphenoidal fissure, or after having caused absorption of bone, from the sphenoidal cells, or through the cribriform plate of the ethmoid bone. Suppuration, compression of the brain, coma, and death, are the only results to be looked for.

A remarkable illustration is recorded by Samuel Cooper, as having come under observation at St. Bartholomew's Hospital. The patient suffered from an enormous polypus, which occupied both nasal fossæ. The eyes were four inches apart, and the left eye was absolutely blind. Paralysis supervened fifteen days before death, which followed a period of coma. On post-mortem examination, it was found that a portion of the growth, almost as large as an orange, was within the skull. The anterior lobe of the left hemisphere of the brain was almost entirely destroyed.

These growths are much more frequently met with in males than in females; they may occur at almost any age, but are most common in young people. In 122 out of 164 cases which have come under my observation, or of which I have collected particulars, the growth evidently commenced in each case before the patient had reached the age of twenty. M. Marjolin records the case of a little girl only two years of age, who died from the effects of a growth of this kind, which had probably commenced during early infancy.[3] On the other hand, Dr. Robin Massé quotes from Richard a case in which the patient was fifty-five years old. But it is quite the exception to meet with an instance at so advanced an age. Indeed, in any case of supposed fibrous polypus of the nose, if the patient has long passed the middle period of life, the growth must be looked upon with suspicion, inasmuch as it will most probably prove to be malignant in character, and not a simple fibroma.

As already indicated, these growths not only give rise to considerable disfigurement and severe suffering, but sooner or later may prove fatal in result. Death may ensue from exhaustion caused by repeated hemorrhage, constant discharge, disturbed sleep, and inability to take sufficient food; or from slow or even rapid asphyxia; or from implication of the nervous centres.

Treatment.—Complete extirpation of the growth by operation is the only treatment upon which any reliance can be placed.

In some rare instances, it is true, naso-pharyngeal polypi have spontaneously sloughed away. In the case of a young woman in St. George's Hospital, Mr. H. C. Johnson "proposed to divide the soft palate, and endeavor to remove the whole growth from the pharynx; when, fortunately for the patient, the morbid tissue was attacked by rapid sloughing, which so entirely removed it, that no trace could be discovered of any part remaining."[1]

A somewhat similar result occurred in the case of a boy under the care of Mr. Birkett, in Guy's Hospital. In this case it was proposed to extirpate the polypus after removal of the upper jaw; but the parents would not consent. On one occasion hemorrhage took place to such an extent as to render necessary the application of a ligature to the common carotid artery. The tumor subsequently sloughed, and the whole came away through a large opening in the cheek. Seven years afterwards the patient was quite well. The sinus in the cheek had healed up. There was no recurrence of the growth.[2]

Instances are also recorded by Saviard,[3] Bonnet,[4] Vimont,[5] and others.[6] But so fortunate an issue is far too rare to justify the expectation of its occurrence.

Local applications, whether of exsiccatives, astringents, caustics, or escharotics, in solution, in powder, or in sub-

[1] Massé, op. cit., p. 17.

[2] See case under the observation of M. Chassaignac, quoted by Massé, op. cit.

[3] "Proceedings of the Société de Chirurgie;" Paris. Gazette des Hôpitaux, May 25, 1861, already referred to.

[1] British Medical Journal, vol. i., 1858, p. 61.

[2] Ibid., p. 119.

[3] Recueil d'Observations chirurgicales, p. 112. Paris, 1784.

[4] Bonnet, tome iv., obs. 92, p. 457.

[5] Quoted by Brevet, Des Polypes naso-pharyngiens, p. 16. Paris, 1855.

[6] See the treatises by Robin Massé and D'Ornellas, already referred to.

stance, are worse than useless. The actual cautery, in the form of the guarded hot iron thrust into the growth, has passed into deserved oblivion; and in like manner the use of the ligature has been well nigh abandoned, on account of the difficulty of its application, the dangers to which it may give rise, and the uncertainty of its results. In some cases, however, it is possible that the growth may be of such moderate size, and its pedicle so situated, that the ligature may be applied, and lead to results at any rate temporarily successful.

In all cases it is necessary to remove the growth completely; for if any portion should be left, there is very great probability of recurrence. Such being the case, and the anatomical relations of these growths, and the size they often attain before coming under treatment, being duly considered, it becomes obvious that it must be very seldom that they can be removed satisfactorily without some preliminary operation by which more space for surgical manipulation is obtained than naturally exists.

Sometimes, however, if the growth has not extended far into the cavities, and more especially if its pedicle is comparatively small, it may be removed through one or other of the natural openings. Thus, I saw my colleague, Mr. Forster, tear away a growth of this kind from the naso-pharynx of a boy in Guy's Hospital by his fingers alone. The result was eminently satisfactory. In another case I successfully removed a similar growth by means of a wire-rope écraseur, the end of which was so curved as to pass round the posterior border of the soft palate.

Mr. Bryant records a very remarkable case in which the growth "had originally appeared in the right nostril, but had ultimately occluded both posterior nares, and pushed forward the soft palate. The écraseur (through the nose) was employed for its removal, but only a small and weak one could be introduced, and the screw could only be tightened gradually. In five days it came away, but the polypus did not fall off; for a time it appeared to shrivel away, but in nine months the boy was sent back to the hospital as bad as ever. The tumor was again carefully examined, and was found to be attached to the posterior wall of the pharynx. On this occasion whipcord was used instead of wire, and again the écraseur came away on the fifth day, but this time the tumor came with it."[1] In this case reunion may have occurred between the parts gradually severed by the wire, or the polypus may have continued to derive its nourishment through some secondary attachment previously formed. Mr. Bryant informs me, he has reason to believe that no reproduction of the growth is again taking place.

In cases in which the pedicle of the polypus can be reached and encircled, it is probable that the galvano-caustic wire may be very advantageously employed.[1] But satisfactory experience of this method without preliminary operation, is as yet wanting. In every case in which the growth has attained considerable size, and is so firmly wedged into the cavities that its points of attachment cannot be easily reached, it is better, as a preliminary measure, to make a full and sufficient opening through the soft parts and bones. Various methods have been from time to time described, and practised with more or less satisfactory results. These methods may be divided into—1st, those which involve complete or partial ablation of the upper jaw; 2d, those in which the upper jaw is temporarily displaced and restored to its position after the removal of the growth; 3d, those in which the face is untouched, and the opening is made through the palate, with or without the absolute removal of the natural structures.

In deciding on the best operation to be adopted in any particular case, the surgeon must be guided by the size, extent, and possibly ascertained attachments of the growth with which he may have to do. In every case sufficient space must be obtained.

Ablation of the upper jaw (entire or partial) is neither so difficult nor so dangerous an operation, nor is it followed by so much after disfigurement, as might be expected; and some modification or other of this method, is probably most likely to prove successful in a large proportion of cases in which the growth has attained considerable size, and has extensively invaded the various cavities.

Temporary displacement of the upper jaw involves some difficulties in the after treatment; but further experience may show how these are to be overcome, and the obvious advantages of the method may be more generally secured.

Operations through the palate alone do not always permit the full exposure of the origin of the growth. This method, therefore, is liable to prove inefficient. Its value, however, is amply tested by many successful cases.

Ablation of the upper jaw to facilitate the removal of a naso-pharyngeal polypus appears to have been first suggested by

[1] Medical Times and Gazette, vol. ii., 1864, p. 126. Also Path. Trans., vol. xviii., p. 106.

[1] Bryk, Wien. med. Halle, 1862, p. 223. This method appears to have been first employed by Middeldorpf, in 1853. See Robin Massé, op. cit., p. 73.

Whateley, and first practised (though with incomplete success) by Syme, in the year 1832.[1] To continental surgeons, however, is due the credit of having fully established the practicability and the value of this operation.[2] It is now generally recognized as a legitimate and successful surgical procedure. Mr. Tatum appears to have been the first in this country to have operated with successful results.[3]

The various operative proceedings for the total or partial resection of the upper jaw, will be found described in the essay on DISEASES OF THE MOUTH.

There are certain obvious objections to the total removal of the jaw. Even if the result should be successful so far as the extirpation of the polypus is concerned, more or less disfigurement remains: the removal of the floor of the orbit may endanger the eye; the teeth on one side are necessarily lost, and mastication may be impaired; and lastly, a large opening remains between the mouth and the nose, and articulation may be seriously affected. The latter several objections may be, for the most part, overcome by the adaptation of an artificial obturator at some subsequent period. The extent, however, to which the chasm left after the operation gets filled up in course of time by firm fibrous cicatricial tissue is very remarkable.

It fortunately happens, that in many cases partial resection of the maxilla suffices to afford the requisite space. The floor of the orbit,[4] and even the dental arch may be left intact.[5]

A good example of partial resection of the maxilla for the removal of a naso-pharyngeal polypus, is recorded by Mr. Pick as having come under the care of Mr. Holmes in St. George's Hospital.[6] The patient (a man), twenty-seven years of age, suffered from characteristic symptoms. "The operation was commenced by a single incision from the inner canthus of the eye, down the side of the nose, and continued through the upper lip in the mesial line. The flap having been dissected up, the bone was first divided by a key-hole saw through the malar tuberosity; the bone was then divided into two, leaving the floor of the orbit, by the bone forceps, carried along the lower margin of the orbit. The other attachments having been divided in the usual manner, and the bone having been severed from the soft palate, it was easily removed, and the origin of the tumor from the base of the skull exposed. The polypus was now grasped, and easily extracted. . . . The flap was readjusted. . . . There was very little bleeding during the operation. . . . The man made a good recovery, and left the hospital with the wound quite healed, five weeks after the operation."

Temporary displacement of the maxilla followed by replacement immediately after the removal of the growth, may be successfully accomplished in the manner illustrated by the following case, the details of which were brought before the Académie de Médecine by M. Huguier, in 1861.[1]

The patient, a young man twenty years of age, had suffered during a period of about six years from the presence of a naso-pharyngeal polypus. Various ineffectual attempts at extirpation had been made from time to time. On admission the left eye was unduly prominent. The left side of the nose generally appeared enlarged, and the left ala was distended. On inspection through the nostril a reddish mass could be seen, and on digital exploration through the mouth, a firm rounded growth could be felt pressing down the soft palate, and filling the left naso-pharyngeal opening, and passing round to the right. The symptoms were severe. M. Huguier operated in the following manner: The mouth being widely opened, an incision was made through the soft palate. A narrow band or skein of thread was then carried by means of Bellocq's sound along the left nasal fossa, passed through the opening made in the palate, and one end of it drawn through the mouth. This was intended to be used in making downward traction on the jaw in the latter stages of the operation. Next, an incision was made through the whole thickness of the cheek, from the left labial commissure to the anterior border of the masseter. A second incision was carried alongside of the nose through the lateral attachment of the ala and through the middle of the upper lip. The flap having been raised, the superior maxilla was cut through horizontally by means of a saw. The line of section extended from immediately above the maxillary tuberosity to a point above the floor of the nasal fossa. The first incisor tooth on the right side having been then removed, the saw was applied from before backwards to the hard palate on the left side of the septum. The base of the pterygoid apophysis was next cut through by means of strong bone forceps. Thus the inferior portion of the maxilla was

[1] Edinburgh Medical Journal, vol. xxxviii., p. 322. See also Verneuil, Proceedings of the Société de Chirurgie, mars 14, 1860.

[2] A full history of the operation, and copious details of the various modifications adopted by different surgeons, are given in the already quoted treatise of Dr. Robin Massé.

[3] British Medical Journal, January, 1858, p. 119.

[4] Guérin, Éléments de Chirurgie opératoire, p. 228. Paris, 1858. Maisonneuve, Gazette des Hôpitaux, août 21, 1860.

[5] Bérard, Dictionnaire en 30 vol., tome xxviii., p. 367.

[6] St. George's Hospital Reports, vol. ii., p. 162.

[1] Gazette des Hôpitaux, 1861, p. 337.

detached from the other bones of the face, and only kept in connection with them by the mucous membrane of the hard palate and alveolar process. By means of a chisel used as a lever, aided by traction upon the band of thread introduced at the beginning of the operation, this portion of the bone was turned downwards and towards the right. In this manner a wide opening was made into the pharynx, and the polypus was seen adhering by a broad base to the basilar process, the back of the pharynx, and the base of the left pterygoid process. The pedicle was cut through, and the polypus removed in four portions by means of a gouge and strong curved scissors. Frightful hemorrhage ensued, but the application of the hot iron proved effectual. The maxilla was replaced, but it was found difficult to retain it in position. The wounds in the face were closed by five sutures. A gutta percha mould was subsequently fitted to the parts, and worn for some time, and threads were passed round the teeth. In spite of the difficulty long experienced in maintaining the parts in proper apposition, the case terminated very satisfactorily.[1]

Other methods, similar in principle to the one described, but more or less different in detail, have been practised and recommended by Langenbeck,[2] Roux,[3] and others.[4] In some cases it suffices to cut through the alæ of the nose along their junction with the cheek; through the nasal processes of the maxillæ and the skin and mucous membrane covering them, and through the septum. When this has been done the nose may be turned forcibly upwards and replaced after the growths thus exposed have been removed.

The method devised and advocated by M. Nélaton,[5] leaves the face untouched, and the superior maxilla undisturbed in position. The operation is performed as follows. The soft palate is first divided in the middle line throughout its whole extent and thickness. A longitudinal incision is carried along the posterior half of the hard palate down to the bone. From the anterior extremity of this incision two others are carried obliquely outwards, one on each side to the root of the alveolar process. The flaps of periosteum and mucous membrane are detached from the bone, and reflected outwards on either side. The bony palate is next perforated, and cut away by means of bone forceps. The mucous membrane and periosteum of the floor of the nose are then divided in the median line, and the flaps turned aside; as much of the vomer as may be necessary is removed. In this manner a large opening is made into the naso-pharyngeal cavity, and the growth that may be there is exposed. After the growth has been removed, and its pedicle completely destroyed by the application of the hot iron or some escharotic, the flaps may be brought together. But M. Nélaton recommends that this should not be done until some time after the operation, nor until the complete destruction of every portion of the pedicle has been effected. At any subsequent period staphyloraphy may be practised. Deglutition and articulation are but little impaired, or not at all.

This method has been adopted and variously modified by many continental surgeons,[1] but it does not appear to have found much favor in this country, on account of the comparatively limited access it affords to the base of the skull, and its probable inefficiency in case the prolongations of the growth should be extensive.[2] But for these objections it would certainly seem preferable to the other methods described. The operation itself is not difficult; it is attended by comparatively little hemorrhage; no obvious deformity results; mastication, deglutition, and articulation are but little impaired, or not at all.

The naso-pharyngeal polypus, by whatever preliminary operation it may have been exposed, must be very carefully removed; no portion of it must be left. Much bleeding is likely to take place if cutting instruments are used, but this can generally be arrested by the actual cautery, or by styptics. It is well in every case to cauterize the point of origin thoroughly by means of the hot iron, the gas-jet of M. Nélaton, the galvanic cautery, or some powerful escharotic.

With the view of avoiding the various difficulties and dangers of such operations as have been thus described, M. Nélaton attempted, some years ago, the destruction of a naso-pharyngeal polypus by means of what may be called the *electro-chemical* method.[3] Two platinum needles, connected one with each pole of a 9-celled Bunsen's battery, were thrust into the polypus, and the current was allowed to pass for some minutes. The operation was repeated at intervals of ten days.

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[1] Gazette des Hôpitaux, 1861, p. 336.

[2] Deutsche Klinik, 1861, p. 281; and Schmidt's Jahrb., cxiii., p. 195.

[3] Gazette des Hôpitaux, 1861, p. 354.

[4] See Robin Massé, op. cit.

[5] Bulletin de la Société de Chirurgie, vol. i., p. 159.

[1] M. Robin Massé, op. cit., quotes or records twenty-six cases, in thirteen of which the results were perfectly satisfactory.

[2] See Mr. Pick's article in the St. George's Hospital Reports, vol. ii., p. 159.

[3] This method is worthy of note on account of the interest recently excited by Dr. Althaus's Treatise on The Electrolytic Treatment of Tumors.

The result is stated to have been eminently satisfactory. The patient left the hospital completely cured.[1] This method may be practised without any serious preliminary operation.[2]

Cartilaginous Growths.

Cartilaginous growths are occasionally, though rarely, met with in the nasal cavities. For the most part they are attached by broad bases to the septum and adjoining parts of the floor of the nose. They cause more or less obstruction to respiration, and alteration of voice. Sometimes they are attended by troublesome coryza and frequent sneezing; these symptoms have been very marked in two cases recently under my observation. Occasionally recurrent headache is complained of. In some cases the septum is pushed towards the opposite side, and thus the appearance on first inspection may be deceptive.

Mr. Ure records a case, the particulars of which illustrate very well the general history of growths of this kind, and the treatment to be adopted. A young man, eighteen years of age, had suffered ever since he could remember from a fulness in the right nostril. The patient had the peculiar "frog-face," supposed to be characteristic of polypus. No air passed through the affected nostril. On examination a tumor was found connected with the septum and floor of the nose, and blocking up the inferior meatus on the right side. Mr. Ure made an incision through the side of the nose, in order to get room, and then gouged out the growth, which was exceedingly compact in structure. The next day there was oozing of blood, and some erysipelatous swelling. The wound healed nicely, and the patient recovered rapidly from his distressing symptoms.[3]

A parallel case came under my own care in Guy's Hospital four years ago. The growth was removed with equally satisfactory result, and when I saw the patient a few weeks ago, there was no appearance of any recurrence.

Osseous Growths.

Exostoses springing from some part or other of the nasal parietes, or from some neighboring bone, may invade the cavities of the nose, and give rise to symptoms more or less resembling those produced by other growths. The degree of hardness and fixity presented on careful exploration, establishes the diagnosis. Very considerable disfigurement may sooner or later result.

In some cases cartilage in variable proportion, and variously disposed, enters into the formation of growths of this kind.[1] One of the most remarkable instances on record is that of Lochland Shiel, an Irish laborer, twenty-four years of age, who was under the care of Mr. Morgan, in Guy's Hospital, in the year 1835.[2]

The patient stated that he first perceived a small tumor in the right nostril when he was fifteen years of age. This gradually increased, and, "at the time of his admission into Guy's Hospital, occupied the whole of the right side of the face; the right nostril being enormously expanded and closed by the enlargement of the tumor, which from its size completely concealed the eye on that side, and extended downwards into the mouth, being there connected with the palatine and alveolar processes of the right superior maxillary bone. . . . The bones apparently implicated in the disease were the ossa nasi, superior maxillary bone, vomer, and the inferior turbinated and malar bones." No description can convey an adequate idea of the size and shape of the tumor, and the enormous general disfigurement produced. "The tumor throughout its whole extent was almost uniformly firm, and of a bony hardness." Mr. Morgan removed the growth (or a great part of it). "A section of the tumor[3] proved that it was composed of an outer hard thin shell of bone, completely inclosing a morbid mass of spongy cancellated structure, devoid of all appearance of sarcomatous or fungoid disease."

The patient made a fair recovery, and lived for nearly seven years. He then died, but the particulars of the termination of the case were not ascertained. It is, however, impossible to look at the cast[4] taken after death without marvelling that life could have been prolonged to such a period. The growth appears to have been simply enormous—larger indeed than the head itself.

True exostoses, whether cancellated, compact, or eburnated in structure, and mixed bony and cartilaginous growths springing from the bones, must be distinguished from those curious "osseous

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[1] Med. Times and Gazette, March 16, 1867.

[2] Robin Massé, op. cit., p. 78.

[3] Similar cases are recorded by Erichsen, Lancet, 1864, p. 152; Bryant, Lancet, 1867, p. 225.

[1] See case recorded by MM. Trelat and Dolbeau, Bulletin de la Société de Chirurgie, 1862, p. 261.

[2] Guy's Hospital Reports, series i., vol. i., p. 403. Sequel, series i., vol. vii., p. 491. Illustrative specimens, Guy's Hospital Museum, No. 166^{32}, wax models, 38^{10} and 38^{12}, cast 65. This case is especially quoted because, in spite of its very remarkable character, it does not appear to be generally known.

[3] Preparation 166^{32}, described as "Cartilaginous Tumor," which was removed from the face.

[4] Cast 65, wax model 38^{12}, Guy's Hospital Museum.

tumors," which are occasionally met with in the nasal cavities and adjoining sinuses, but in no other part of the body. The history of tumors of the class now referred to, is at present very imperfectly made out. Instances are very rare, and the opportunities afforded for investigation are necessarily very limited.

The so-called "*Osseous Tumors of the Nasal Fossæ and Sinuses of the Face*," appear, according to recent researches,[1] to originate in the membranes, mucous or periosteal, which line the cavities, rather than to spring, like true exostoses, from their bony parietes. At any rate, they comparatively early separate from the normal bone, if even they have been in the first place connected with it. It has been suggested that these growths may be somewhat analogous in their mode of development and subsequent separation to the antlers of the *Cervidæ*. In the several instances that have come under observation, they have increased until they have attained very considerable size, and have produced very great disfigurement, accompanied by more or less severe suffering. In the majority of cases, they appear to have taken their origin in the frontal sinuses, or in the nasal fossæ. In some instances they have "sloughed" away spontaneously, as in the celebrated case recorded by Mr. Hilton.[2] In others, they have been successfully removed by operation, as in the following case recorded by M. Legouest,[3] which may be quoted in brief by way of illustration.

The patient, a young soldier, had suffered for many years with uncomfortableness in the left nostril, which had obliged him frequently to introduce his finger. One day he felt far back a small swelling, which appeared to be on the floor of the cavity. Seven or eight months afterwards this swelling was as large as a bean, and as hard as a stone. Some time subsequently the nose became deformed, and four months later the growth completely filled the left nasal fossa, and a disagreeable discharge flowed from the nostril. Severe headache and frequent epistaxis soon supervened, and the discharge became purulent. Under such circumstances the aid of M. Legouest was sought, eighteen months after the appearance of severe symptoms. A hard immovable tumor with irregular surface could be felt occupying and distending the left nostril. The soft palate was depressed, and behind and above it could be felt a larger tumor than that which occupied the anterior part of the nose. The patient breathed through the mouth only, and swallowed with difficulty. The voice was nasal. An abundant sanious and purulent discharge flowed from the nostril. After a tedious preliminary operation, terminating in partial resection of the upper jaw, the whole of the growth was removed without difficulty, but *no point of bony attachment could be discovered*. The patient made a good recovery. In size, form, and general aspect, the growth resembled somewhat the os calcis. Its surface was uneven—smooth in some parts, rough in others. Its substance was very dense, very compact, and eburnated. It was impossible to make out any vestige of a pedicle.

Several similar cases are quoted by Dr. Olivier in his treatise on these tumors. The general conclusions indicated are, that such tumors differ from ordinary exostoses, not only in their mode of development, but also in the method of treatment to be adopted. Ordinary exostoses must be cut off from their attachments; but these "osseous tumors" require the full and complete exposure of the cavities in which they lie, and they may then be turned out without any further difficulty. If allowed to remain, they go on increasing in size until by the pressure they exert, they cut off their own supply of nutriment. They then spontaneously separate and slough out, after having caused more or less extensive destruction of the parts upon which they may have pressed.

Malignant Growths.

Osteo-sarcomatous, sarcomatous, encephaloid, and much more rarely scirrhous growths, sometimes invade the nasal cavities, or spring directly from their walls. Such growths, as a rule, commence in the bones themselves, or very speedily involve them. They generally occur in young children, or in those who have passed the middle period of life.

The age of the patient, the appearance of the growth, its proneness to bleed when touched, the foulness of the discharge to which it gives rise, and the general cachexia with which it is associated, indicate the character of the growth. If any doubt should remain, the microscopical examination of a small portion of the growth removed by avulsion, or by means of a grooved needle or fine trocar and canula, readily determines the diagnosis.

In four cases that have come under my observation, in each of which the symptoms generally resembled those associated with benign polypus, it was noticed that the soft palate, though stretched and de-

[1] Dolbeau, Bulletin de l'Académie de Médecine, tome xxxi., p. 107. Dr. Paul Olivier, Sur les Tumeurs osseuses des Fosses nasales; Paris, 1869. Compendium de Chirurgie, tome iii., pp. 98 et 564.

[2] Guy's Hospital Reports, series i., vol. i., p. 495. Museum Prep. 1666[48], drawings 3[50], 3[51], 3[52].

[3] Mémoires de l'Académie de Médecine, 1865–66, p. 147.

pressed, was red and thick to the touch, instead of being pale and thin, as is commonly the case when it is pressed down by a mucous or fibrous polypus.

As a general rule, it may be stated that if the malignant character of the growth is indisputably established, it is better to let matters take their course; for in this situation it is well nigh impossible to effect such complete extirpation as can be of any real benefit. In some cases, however, if the nature of the disease is recognized early, and its progress is not rapid, it may be not only justifiable, but even advisable to attempt the removal of the growth. But if this should be attempted, all the adjoining parts likely to be infected must be removed also. In this way, life may sometimes perhaps be prolonged, or at any rate suffering may be diminished.

Note [to 2d English edition].—In preparing this Essay, free use has been made of that by Mr. Ure in the former edition of this work. But so many additions have been made, and the sections of that treatise have been so far modified, that the Essay may be considered as an original one—for which the present author is solely responsible.

DISEASES OF THE TONGUE.

By Holmes Coote, Esq.

Revised by Charles McBurney, M.D.

The tongue, an organ of well-known form, to which the sense of taste is chiefly referred, is composed of muscular and of gland-substance, covered by mucous membrane, continuous with that of the mouth and fauces. The more delicate appreciation of taste is limited to the upper surface, where the papillæ of the mucous membrane are remarkably developed. The proper muscular structure is striated and arranged in two horizonal and many vertical layers; the former, immediately subjacent to the mucous membrane, are to be found on the upper and under surfaces; the latter pass vertically from one horizontal layer to the other, connecting them, but leaving intervals, which are occupied by gland-structures, supplied by ducts opening on the under surface, and secreting a fluid resembling saliva. In the posterior third, the muscular prevails over the gland-structure, which is reduced to two large lateral bodies. Abundantly supplied with nerves and bloodvessels, always in movement, and exposed to many sources of irritation or injury, this organ often becomes the seat of disease.

I know of no well-authenticated instance of atrophy of the tongue, although we have now on record many cases of progressive muscular paralysis involving for the most part not only the tongue, but also the palate and lips: such cases must be referred to diseases of the nervous centres. Congenital tongue-tie is also unknown to me. The frænum, it is true, extends in some cases to the tip of the tongue, when its division may be easily accomplished; but the defect usually produces little or no inconvenience, and the difficulty of utterance with which it is frequently associated proceeds from causes affecting the sensorium. Still the division of the frænum linguæ is an operation somewhat popular, and may be performed without detriment to the patient. Whenever the operation is performed, let it be remembered that the artery of the frænum may proceed from the sublingual and not from the ranine arteries; and that the rule given to keep the point of the scissors downwards towards the floor of the mouth is hazardous. It is better to use blunt-pointed scissors and to cut as little as possible and directly backwards.

[Most authorities agree in saying that congenital tongue-tie is not unusual, and that when the deformity exists in a marked degree, it presents a decided obstacle to sucking.

In some very rare cases the tongue has been found adherent to the palate (Follin and Duplay). More frequently the adhesion has existed between the tip and sides of the tongue and the floor of the mouth. The adhesion is usually soft and easily broken down with the finger or a spatula. M. Sernin, of Narbonne,[1] records the case of an infant three months

[1 Quoted by Fairlie Clarke, Diseases of the Tongue, p. 42.]

old, which was brought to him on account of difficulty in sucking. "The tongue was found adherent to the lower jaw throughout its whole breadth." No movement sufficient for suction could be made. By careful dissection the tongue was entirely freed and the child obtained complete relief. To prevent readhesion, the finger or a camel's-hair brush, dipped in sugar and water, was passed between the cut surfaces two or three times a day.

Bifidity of the tongue, which is a normal condition in some animals, as the seal, and in some birds and reptiles, has been met with in the human species. It is almost always associated with other deformities, such as hare-lip and cleft palate.

Congenital absence of the tongue has also been noted, as in the case reported by M. de Jussieu.[1] In this case, that of a girl fifteen years of age, instead of a tongue, a small elevation only was found, which rose to the height of three or four lines in the middle of the mouth. On pressure upon this, a movement of contraction took place, showing that at least rudimentary lingual muscles were present.

Fairlie Clarke[2] says that there are cases "in which the loss of power (from paralysis) is accompanied by well-marked wasting and a visible decrease in the size of the affected part" (the tongue). "These groups of cases are (1) those in which there is disease of the medulla oblongata involving the hypoglossal nucleus, and (2) those in which the ninth nerve is diseased or injured, between the cerebrum and the muscles to which it is distributed." The same author quotes a number of illustrative cases.]

Hypertrophy and enlargement of the tongue ("lingua vituli, lingua propendula, macro-glossia," etc.) is an affection occasionally seen.

Zacchias[3] relates that he saw at Rome, in 1628, a male infant well made, except that the tongue projected three fingers' breadth from the mouth. The child could suck, and lived to the age of fourteen months, when it died without obvious cause. Bartholin[4] mentions a case of "linguæ portentosa magnitudo," related to him by his pupil Bagdun: a male child, born with the tongue out of the mouth as large as a filbert. As the child grew, the tongue increased to the size of a calf's heart. Sauvages, in his Nosologia, speaks of enlargement of the tongue in newborn infants. Percy and Laurent[5] speak of two cases: one a woman, in whom the enlargement was dated from birth, but rapid increase took place at the age of three. The other was that of a boy, aged sixteen, whose tongue hung three inches below the chin, was two inches and a half thick, and filled the mouth. The affection had existed from birth.

In Mirault's case, the man, aged thirty-four, had suffered from infancy; so likewise in that related by M. Maurant.[1] In other cases the enlargement is described as commencing in the first or second years, when perhaps the better expression would have been, "was then first noticed;" for the tongue is an organ in which hypertrophy in a slight degree might be readily overlooked, especially in early life, and before attempts are made at articulation. In a few other cases the beginning of the swelling in adults has been referred to salivation. Hypertrophy of the tongue as seen in infancy is congenital.

[According to the investigations of Wegner[2] and Virchow, congenital hypertrophy of the tongue bears a close similarity to the disease known as elephantiasis. It begins as a disease of the lymphatic vessels, and comes properly under the head of lymphangioma. In consequence of some difficulty in the passage of lymph from the tongue the lymphatics become dilated, and here and there large lymph spaces are formed. Some of these spaces are filled with lymph corpuscles, while into others from time to time veins burst; the connective tissue of the organ becomes largely increased, while the muscular fibre atrophies.

Hypertrophy of the tongue, therefore, is a disease which tends to slowly increase. The crowding which the enlarged organ receives from the mouth, the folding of the mucous membrane so as to form fissures, and the injuries received from the teeth, cause attacks of glossitis, each attack leaving the tongue more enlarged than before.[3]

In cases of acquired hypertrophy, the disease begins in an inflammation which arises either "spontaneously" or as the result of wounds or mercurial salivation, or occurs in the course of typhus, scarlet fever, etc.[4]

In the hypertrophies of the tongue and lips,[5] dilated lymph vessels are found, containing a fluid similar to lymph, and

[1] Histoire de l'Académie avec les Mémoires de Math. et de Physique, tome i., p. 6.]

[2] The Diseases of the Tongue, p. 56.]

[3] Quæst. Med.-leg., lib. vii., tit. 1, quæst. 9.

[4] Hist. Centur., iii., p. 85.

[5] Dict. des Sc. méd., vol. xxvii.

[1] Journ. de Méd., vol. xv.

[2] Langenbeck's Archiv, vol. xx., p. 64.]

[3] Kœnig, Lehrbuch der Speciellen Chirurgie, 1878.]

[4] The Diseases of the Tongue, Fairlie Clarke.]

[5] Manual of Pathological Histology, Cornil and Ranvier, edition 1881.]

situated in the midst of thickened fibrous tissue.]

The measurement of the tongue in the case of a child of eleven, under the care of Dr. Humphry,[1] was as follows: from the upper lip to its tip, 3½ inches; from the under lip to its tip, 1½ inch; from the angle of the mouth round the sides and tip to the opposite angle, 6¼ inches. The circumference of the widest part, which was about the middle of the protruded portion, measured 6½ inches circular measurement; immediately within the lips, 5 inches. When drawn into the mouth to the utmost possible extent, the tongue measured from the upper lip to its tip 2 inches. The organ was soft and supple, having been kept habitually covered in a bag hung from the head. The papillæ were greatly enlarged, and separated by deep clefts, giving to the exterior of the mass a coarsely granular or warty appearance. The color of the organ was natural. The opening of the mouth was large, the lower lip everted, and the angles of the mouth depressed, so as to elongate and give a peculiar expression to the face. The orifices of the sublingual ducts, of unusual size, were situated just in front of the edge of the lip; the saliva was continually dribbling from the end of the tongue, the quantity thus lost amounting during the day to more than half a pint. Owing to the constant pressure of the tongue on the mental portion of the lower jaw, a curvature had taken place in that bone just in front of the masseter muscles, in such a manner that a wide interval always existed between the incisors and bicuspids of the two jaws. Even when the mouth was closed, that is to say, when the corresponding molar teeth were in contact, this interval between the incisors measured nearly two inches, being increased by the horizontal direction which the inferior incisors and the alveolar process of the lower jaw had assumed. These were so placed as to form a wide channel, in which the tongue rested.

Dr. Humphry determined to remove the protruding part of the tongue by excision, although he was aware that a fatal case had occurred elsewhere from this practice.[2] He passed a straight bistoury from below upwards through the organ a little to the left of the middle line, and cutting forwards and outwards formed a left lateral flap. He then secured a vessel. Next he cut across the middle of the tongue, divided the ranine arteries, the movements of the organ being still controlled by means of the prolapsing portion, which was not quite severed. The operation was completed by the formation of an oblique lateral flap on the right side, corresponding with that on the left. The flaps were approximated so as to form a tip, and maintained in apposition by two sutures passing deeply. The hemorrhage was not very great, and the bleeding vessels were tied without difficulty. A good deal of swelling of the tongue followed the operation; but under frequent washing and fomentation it soon subsided, and the wound healed. At first the lips could not be approximated, and the thick stump of a tongue was always visible, though never protruding. After a few days, however, by continued action of the orbicularis muscle, the mouth was closed. An apparatus was then constructed to act by pressure on the deformed jaw, and ultimately a result was obtained highly creditable to the operator.

The effect of continued pressure on the enlarged tongue is a mode of treatment only applicable to early cases, and is uncertain in its results. In a case under the care of the late Mr. Crosse, the swelling, partly removed by this method of treatment, soon returned, and the relief appears to have been imperfect. Some surgeons have treated such a case by ligature; but to this proceeding an objection offered itself in the formation of a slough occupying the anterior part of the mouth, and in the immediate proximity of the nostrils.

The écraseur is an instrument generally unsuited to operations about the mouth, fauces, or tongue; but may be advantageously used whenever there is fear of uncontrollable hemorrhage. There is this disadvantage attending its use: that as the chain becomes tightened, it draws nearer and nearer to the limits of the disease, so that when the operation is completed and the part removed, the line of section will often be found in dangerous proximity to the diseased structures. I think that the fear of dangerous hemorrhage is somewhat exaggerated, except in the case of operations performed at the root of the tongue.

["In estimating these various plans of treatment, we may, I think, conclude that pressure, combined with the use of astringent solutions, is equal to the cure of any case that has not attained a great size; and especially if the organ can be reduced into the mouth, and the teeth kept in apposition by a bandage, a cure may be confidently expected without operation."[1]

Fairlie Clarke gives a table of 43 cases of hypertrophy of the tongue, reported by different authors, which were treated by various methods. Of these, 9 cases were treated by compression, or by compression combined with the use of astringents, and are reported as "cured."

[1] Holmes, Surgical Treatment of Children's Diseases.]

[1] Med.-Chir. Trans., vol. xxxvi., p. 114.

[2] A girl, aged fourteen, in whom the enlarged tongue hung out of the mouth three inches, was under the care of Mr. Syme, who removed the prolapsing part by oblique incisions meeting at an angle in the centre of the tongue, and united in the middle line by sutures. The child died a few days after, from inflammation and swelling of the tongue and parts about the larynx.

The same author says, "whether the compression is applied directly to the tongue, or immediately by returning the organ into the mouth, and supporting the lower jaw with a bandage, must depend upon the circumstances and the severity of the case. If the former method is used, the best plan is to apply a piece of lint dipped in a strong astringent lotion round the protruded tongue, and over this to wind a tape or strips of adhesive plaster. The best applications to use arealum, sulphate of copper, or tannin." . . . "If the case is suitable for indirect pressure, the best method is to have a calico or flannel bandage, with a hole cut to receive the chin, and two or three tapes to secure it upon the vertex." . . . "Whatever compressing bandage is used, it should be removed frequently, especially at first to allow the patient to take food, as well as to rinse his mouth with an emollient, astringent, or refreshing wash."

The galvano-cautery can be used with advantage in all cases to which the écraseur is applicable, that is, in cases where it is only necessary to cut off the protruding mass. One should be careful to use a *large* wire, heated to such a degree only as will enable it to cut, or rather burn, *very slowly*, through the tissues. Passing two or more stout pins through the tongue, and placing the loop of wire behind the pins, will prevent the gradual slipping forward of the loop as it is tightened.

The following condensed notes of a case of congenital hypertrophy of the tongue are taken, with the permission of Dr. Henry B. Sands, from the history book of the New York Hospital. I. S. T., aged 3 years, came under the care of Dr. Sands in November, 1880, for the treatment of congenital hypertrophy of the tongue, which had been aggravated by a wound received in a fall occurring about one year before admission. The tongue protruded three-quarters of an inch from the mouth. On November 9, with the galvano-cautery wire loop, Dr. Sands removed one inch of the tongue. "Very little swelling followed. No hemorrhage. Slough disappeared on the 18th. Balance of tongue nearly fills the mouth."

The propriety of operating upon these cases during the first years of life is evident. The longer an hypertrophied tongue hangs from the mouth, the greater becomes the deformity of the teeth and lower jaw (as seen in Dr. Humphry's case reported above). By an early operation, the necessity for much of the later treatment may be avoided.]

Acute inflammation of the tongue, attended with sudden enlargement, is a disease occasionally seen. Mr. S. Cooper remarks that it may arise spontaneously, and without any apparent cause; or else from some particular irritation, such as that of mercury or some poisonous substance.[1]

He mentions that, in the middle of the seventeenth century, Schlegel, who was at Paris, saw a patient in salivation, whose tongue became so enormously enlarged that the mouth could not contain it. Pimprenelle, an eminent surgeon of the time, was sent for, and amputated one half of the organ; a measure which Louis criticizes as extremely violent.

[Fairlie Clarke gives, as causes of acute glossitis, an ordinary "cold;" the contact of septic substances, or of a tainted atmosphere; the taking of corrosive or acrid substances into the mouth. According to the same author, this affection sometimes occurs in the course of fevers or eruptive diseases.

Cases of glossitis occur in which only one side of the tongue is affected.

Dr. Graves, in the Dublin Hospital Reports, vol. iv., p. 42, narrates an instance. "M. B., a medical student, solicited my attendance. I found him laboring under severe febrile symptoms of a week's continuance, ushered in by violent rigors, great pain in the neck and occiput, somewhat relieved on the second day by profuse epistaxis. The left half of the tongue became then very tender and painful, and gradually increased in size; at my first visit it was enormously swollen, and nearly filled the entire cavity of the mouth, which could scarcely be closed on account of the protrusion of the tongue. The right half of the tongue was perfectly natural, and its comparatively diminutive size formed a striking contrast with that of the left, the median line forming a perfect boundary between the swollen and the healthy parts. Two or three applications of six leeches at a time to the inflamed half, part of which at my first visit appeared on the verge of gangrene, produced a speedy decrease of the tumor and inflammation."]

The disease to which I now refer, however, proceeds from occult atmospheric causes. The swelling is sudden, perhaps occurring during the course of the night, and it produces feelings of threatened suffocation, having been preceded by loss of appetite and a general sensation of *malaise* for a few days.

The first case which came before my notice was that of a gentleman aged 60, of remarkably abstemious habits, living chiefly on vegetable diet; the second, that of a young married lady residing in lodgings in a healthy part of London. In this latter case the swelling of the tongue was so great that the mouth could not

[1] Surg. Dict., ed. 1830, p. 1102.

be closed; the teeth became coated with sordes, and a profuse watery and highly fetid discharge flowed without intermission for many days. The patient feared to close her eyes in sleep; and so difficult was the respiration, that at one time the question presented itself, whether it might not be necessary to make deep incisions into the swollen organ, or even to open the trachea. However, by constant attention to cleanliness and gargling, by the local use of ice, by supporting the strength with wine and quinine, and the administration of nourishment by enemata during a short time when deglutition was impossible, the swelling subsided, and the patient recovered. For some weeks, however, she remained in an enfeebled state. I saw about the same time two other cases in St. Bartholomew's Hospital. In both the disease was rapid in its course, the accession lasting but a few hours, and the swelling usually subsiding within a week.

But during the period of acute œdema of the tongue, the patient may die suffocated; and the surgeon should bear in mind that such an accident may be prevented by his making free and deep longitudinal incisions into the swollen organ. "I have seen a patient," observes Mr. Erichsen, "who was nearly suffocated by the immense size of his tongue, relieved at once, and get nearly well in the course of a few hours, by such incisions."[1] These incisions should be made along the upper, rather than the under surface of the tongue, that the ranine artery be not wounded; and there is but one caution: the œdema may so far involve only one side of the tongue as to cause the lower surface, which yields the more readily, to be turned *directly upwards*, in which case the incision made above passes in truth into the tissues normally inferior. Such a case happened in the practice of Mr. Wormald, who found that, upon the subsidence of the swelling, the incision made above gradually acquired a directly inferior position.

I have known tracheotomy deemed necessary in such a case, although the symptoms do not usually demand it. The condition of the mouth prevents the administration of medicines during the acute stage. Afterwards we must be guided in the selection of remedies by the state of the pulse. Should there be much fever, saline and diaphoretic remedies are suitable. But more commonly the indication is to support the strength, by the administration of tonics, wine, and nutritious diet. For the mouth, a gargle containing alum, or borax and honey, or tincture of myrrh, may be used; and the surgeon may give much relief by carefully wiping away the thick viscid secretion from the teeth, and by touching any ulcerated spots with a weak solution of nitrate of silver.

In the Museum of Guy's Hospital there is a preparation of a portion of a tongue, weighing two ounces and three drachms, removed by ligature by the late Sir Astley Cooper, in consequence of enlargement following salivation produced by mercurial medicines in the treatment of syphilis. And another preparation (1672) illustrates the extreme effects of mercury, namely, mortification of the organ; a result extremely rare, and due to the injudicious and long-continued administration of this powerful agent.

Abscess.—I have seen several cases of abscess of the tongue.

One case was that of a lady of middle age under the care of Mr. Stanley. She had a firm tumor, the size of a large pea, embedded in the substance of the tongue. Considering the patient's age, and the symptoms attending the formation of the tumor, Mr. Stanley could not dismiss from his mind the idea of carcinoma. But its situation in the middle of the substance of the organ militated against that idea. He made an incision into the mass, and a small quantity of healthy pus escaped. The wound cicatrized, and the lady has continued in good health ever since.—Mr. Erichsen[1] says, "Abscess of the tongue, though rare, occasionally occurs. A boy was brought to me some time ago with an elastic fluctuating tumor of slow growth and about the size of a small plum, situated deeply in the centre of the tongue. On puncturing it, about half an ounce of healthy pus was let out, after which the cyst speedily closed." Other similar cases are met with scattered through medical literature, and they show that the gland-follicles of the tongue are liable to suppuration.

[Simple inflammation of the tongue may terminate in abscess, or acute abscess may be the result of wounds.

In these cases, in addition to the symptoms of ordinary glossitis, will be found excessive pain and tension more or less circumscribed. With the formation of matter occur chills. Early incision into the affected part is, of course, of the utmost importance, and generally gives immediate relief. Should there be any question as to diagnosis, the exploring needle or small trocar will clear up the doubt.

A case of unilateral abscess of the tongue, which was under the care of Mr. Bellamy at the Charing-Cross Hospital, is reported in the Lancet for 1877, page 835. The patient was a child, aged seven, who presented herself with a very painful swelling of the right half of the tongue. The swell-

[1] Science and Art of Surgery, Am. ed., 1881, vol. ii., p. 501.

[1] Science and Art of Surgery, Am. ed., 1881, vol. ii., p. 501.

ing was large enough to render protrusion of the tongue impossible, and seemed to have been caused by a small wound of the under surface of the organ. By the use of a lancet a large quantity of pus was evacuated.

"Not infrequently after abscess fistulæ are left for a long time, which lead to indurated parts, and even without abscess a fibrous induration of the tongue has been noticed as the result of a phlegmon."[1]]

Chronic ulceration.—"The most frequent forms of disease in the tongue," observes Sir W. Lawrence,[2] "are, ulceration, generally superficial, sometimes more deeply seated; swelling and thickening of the mucous membrane; swelling and induration of the substance of the organ. Ulceration often exists in conjunction with swelling of the mucous membrane and with induration of the lingual substance. The more formidable diseases of the tongue are syphilitic or cancerous; the former being by far the most numerous. Disorder of the digestive organs is sometimes the source of the mischief, giving rise to affections which are usually superficial, but sometimes of more serious character. When maintained by imprudent indulgence in drinking, there is often a sore state of the organ, the epithelium being smooth, reddened, or white and opaque. When the surface is superficially ulcerated, the ulcerations are generally small, circular, and of grayish color; occasionally there is thickening of the mucous membrane, and deeper ulceration." In the same volume of the Medical Gazette (p. 800), Sir W. Lawrence relates some cases in illustration of these points.

A healthy-looking gentleman, between forty and fifty, who had always enjoyed excellent health, but who had lived freely, became the subject of the following condition of the tongue: the mucous membrane over the greater part of the organ was unnaturally smooth, more or less opaque and white, here and there raw, as if it had been ulcerated. It had been in this state, generally causing much pain, for four or five years. Under a course of mild mercurial medicines, the employment of tincture of myrrh as a gargle, and abstinence from strong drink, the pain ceased in a week; and the general condition of the tongue was improved, although the surface remained smooth and white, but otherwise sound.

A lady, between fifty and sixty, of unhealthy appearance and with a red pimply face, who had often suffered from disorder of the digestive organs, consulted the same surgeon for a disease of the tongue of formidable appearance. The middle and upper part of the organ was swollen, and occupied by a deep ulcer of irregular figure and foul aspect. It was very painful, interfering with mastication and articulation. The digestive organs were much disturbed. The complaint yielded speedily and effectually to simple measures, regulation of diet and the digestive organs, small doses of extract of henbane, and soothing local remedies.—Some years ago a patient, about fifty years old, came from the country to consult Sir W. Lawrence. The man was of sallow aspect, and had lived freely. On the upper surface of the tongue, in a space about an inch and a half long by an inch wide, the mucous membrane was thickened, indurated, and raised into irregular prominences, which were smooth and not ulcerated. The complaint had existed some months, having become so painful that he could hardly take food; washes and gargles had been of no benefit. There was no suspicion of syphilis in this case; and the habit of drinking, especially spirits, sufficiently accounted for the disease. Sir W. Lawrence prescribed the compound decoction of sarsaparilla with compound decoction of aloes three times a day, four grains of the extract of hyoscyamus at night, and a strictly regulated diet. When again seen at the end of a fortnight, all the pain had ceased, and he could masticate anything. He considered himself well, and returned to the country.—I saw a tall, spare-looking man, aged sixty, March 18th, 1860, in whom the gums had shrunk from the teeth, leaving the roots denuded to the alveolar border, and exposing them to an accumulation of tartar. The patient had lived freely, having been a publican. The whole of the tongue was swollen, smooth, and of glistening red hue. There was no trace of the papillæ, except at the base, where the papillæ circumvallatæ appeared hypertrophied. In those situations where the organ rubbed against the exposed and roughened teeth, the mucous membrane was white and thickened, and seemed to surround numerous small and unhealthy-looking ulcerations. I directed this patient to have the teeth examined and cleaned by a competent dentist; imposed a strictly regulated diet, ordered a gargle containing alum, and occasionally aloetic aperients. Considerable improvement took place; but after a time the patient declined to attend to the strict regimen which was considered necessary.

This smooth glazed condition of the tongue differs from that commonly seen in persons suffering from chronic dyspepsia, though habitually abstemious. In these latter cases, the mucous membrane has a red, uneven, and raw aspect; it is deeply fissured, ulcerated in spots; the papillæ may be universally or partially hypertrophied, or portions may acquire between the fissures a "knobbed" aspect. It is important to distinguish these different affections, and to trace the morbid changes to their proper cause. Above all, it is necessary to distinguish them at

[1] Kœnig, Lehrbuch der Speciellen Chirurgie.]

[2] "Clinical Lecture," reported by Mr. Coote, Medical Gazette, 1845, p. 703.

the earliest stage from those more serious affections, syphilis or cancer. The former appears in a variety of forms, and under circumstances perhaps unexpected. The latter, more definite in its symptoms, is, however, often masked at its commencement by circumstances which will demand all the surgeon's accuracy of diagnosis. Induration of the tongue is said to be of syphilitic nature when it occurs in the centre of the organ, and to be of cancerous nature when it commences at the margin. And this is generally true; but yet there may be an indurated condition of the tongue neither malignant nor syphilitic.

A hatter, aged sixty-one, of unimpaired constitution, who had never had syphilis since the age of eighteen, found that whenever he had been exposed to the fumes of some secret composition used in his trade, the tongue became sore, cracked and dry, and remained so two or three days. For the last three years it had swelled and become painful during the winter months, but returned to its natural state with the approach of warm weather. About four months before he was seen, the back part and left side of the tongue swelled up in an unusual manner, and became hard. This was attended with a dull aching pain. The surface was uneven and tuberculated, and presented several superficial ulcerations not extending beyond the mucous membrane. The hardness resembled that of scirrhus. The absorbent glands under the jaw were not affected. Iodide of potassium was tried without effect. A course of mercury was next administered, under which the gums became sore, and the organ recovered so much of its normal character that the patient was pronounced convalescent.

[This lesion has been carefully studied during the last few years only, and even now the difficulty, in some cases of this character, of making a positive diagnosis, is acknowledged by the most experienced. Two classes of patients are met with: first, those who, having already marked symptoms of tuberculosis in other organs, as in the lungs or larynx, develop an ulceration upon the tongue of the same nature; and second, those in whom the first appearance of tubercle is in the tongue. In the second class of cases the difficulty of diagnosis may be so great that the character of the disease cannot be decided upon without the aid of the microscope. In a doubtful case this means of arriving at a positive conclusion should always be made use of, a small portion of the edge or surface of the ulcer being removed and submitted to a careful microscopic examination. For, as Nedopil[1] says, while a few days of energetic treatment will serve to make clear the character of a syphilitic ulceration, yet if the ulceration proves not to be syphilitic, one may still have to decide as to whether it be epitheliomatous or tuberculous.

Before ulceration has begun, yellowish, clearly defined, slightly prominent points of the size of a pin's-head can be recognized on the surface of the tongue. These points may be spread out so as to form patches, or massed together so as to form a firm swelling. After a few days the epithelium separates, leaving an ulcerated surface, on which may be seen the single points of tubercle, with granulation tissue between and around them. Often, at the beginning, several small ulcers form, which rapidly unite in a single one.

The tuberculous ulcer is generally superficial, with a nearly smooth, red surface. When deep, as it may be, it has a grayish-yellow color. The base is only slightly indurated. About the ulcer the mucous membrane is red, swollen, and marked with yellowish points or patches. While the upper surface and borders of the tongue near the tips are the parts generally affected, the ulcer may occur at any part of this organ, and may spread so as to involve the palate or tonsil. Pain is generally very great, and is much increased by the passage of food and the rubbing of the teeth. As a rule the submaxillary glands are not affected, but when the ulcer has existed for a long time they may become both enlarged and painful. The ulcer may heal at one point, while it spreads at another, and in general it spreads more slowly than epithelioma. The extreme pain and difficulty of swallowing sufficient nourishment call for active treatment in these cases. Morphine sprinkled upon the surface gives temporary relief from pain, and iodoform and other cleansing agents may be used. Early excision of the diseased part is doubtless the best treatment. The wound left heals readily, and though the patient cannot be expected to overcome the general diathesis, yet he may, through operation, be spared much pain, and life may be prolonged. After excision, the edges of the wound should be brought together with stitches. Nedopil reports four cases of tuberculous ulcer of the tongue treated by excision at Billroth's clinic. In all, the disease was supposed to be epithelioma, but a microscopic examination made after operation showed the true character of the ulceration. The edges of the wounds, brought together with stitches, united in all the cases from three to five days.]

[1 Dr. M. Nedopil, in Langenbeck's Archiv, vol. xx. For a description of this disease, the writer is also indebted to Kœnig, Lehrbuch der Speciellen Chirurgie, and to Follin and Duplay, Pathologie Externe.]

Nævus of the tongue.—

On March 15th, 1852, I saw a private patient under the care of Sir W. Lawrence, suffering from congenital venous swelling involving the right border of the tongue. The part had a livid-blue color, with rounded and irregular surface, marked by large tortuous veins. Sir W. Lawrence made an incision into it, and evacuated a quantity of fluid venous blood, by which the bulk of the tumor entirely disappeared. A ligature was then applied to arrest the hemorrhage, when there was renewal of the swelling to even a greater extent than before. The venous trunks still communicated one with another. Ultimately the case did well.—A student at St. Bartholomew's Hospital showed me in 1853, on his own person, a large congenital venous nævus of the tongue, occupying its right half, including both upper and under surface. At one time it used to bleed; but it had long ceased to cause him inconvenience, and had been stationary for many years. Bearing in mind the fact that nævi may first become stationary during the growth of the body, and ultimately disappear, I recommended this gentleman to let the disease take its course; and I was strengthened in this opinion by the remembrance of an examination made of a similar nævus removed from the anterior part of the abdomen of a young gentleman of about twenty, in whom it was found that the venous swellings were undergoing a process of atheromatous or fatty degeneration, and that no further enlargement was, under ordinary circumstances, to be feared.

There is difficulty in the treatment of such an affection if the growth can be neither tied with a ligature nor extirpated by the knife. An organ so movable and highly sensitive as the tongue does not well bear the application of powerful caustics in any form; and proceedings which are practicable in other parts of the body are counter-indicated, both on account of the œdema to which they may give rise, and the subsequent pain and difficulty of deglutition. Fortunately, nævi of the tongue are uncommon, and do not usually acquire great magnitude. When extirpation is thought right, the surgeon may remember that the hemorrhage, though profuse, may be generally controlled by ice. When the ligature is to be applied, it is usually introduced by a strong curved needle; the tongue being drawn forward by an assistant, who holds the organ, covered at the front part by a towel, between the thumb and forefinger of the right hand. No instrument can press and hold the tongue with the same certainty as the human hand.

[A very certain method (one now generally adopted) of controlling the tongue, is to pass a long and strong ligature through it. The two ends of the ligature are then brought out of the mouth and tied together. By dragging upon this ligature, one can place and hold the tongue in any desired position.]

On May 17, 1847, Sir W. Lawrence removed a small vascular tumor of the tongue from a young lady aged nineteen. She had previously had removed a vascular tumor from the gum of the lower jaw opposite the incisor teeth, one of which had been extracted. On microscopical examination of the extirpated parts, I found that the papillæ of the tongue, about the centre of the tumor, were hypertrophied and agglutinated into a prominent and flat-surfaced mass of whitish color. It was composed of white fibrous tissue, of stringy, fibrous matter, and of an immense quantity of mucus and of epithelial cells. It seemed, upon section, as if the follicular portion of the mucous membrane was much enlarged and hypertrophied, and covered by altered and thickened papillæ.

Mr. Paget says, "In the Museum of the Middlesex Hospital is a fatty tumor, one and a half inches long, which was removed from beneath the tongue, where it looked like a ranula; and in the College Museum, No. 190, is one taken from the substance of the tongue." This surgeon also states that he removed an oval bilobed tumor, about half an inch in diameter, from the tongue of a young man, from the substance of which, near its apex, it had been growing for three years. It was firmer than most others of a similar kind, yet succulent, and formed of an obscurely filamentous tissue, abundantly nucleated.[1]

[Simple warty growths are met with, though rarely, on the surface of the tongue. The case of an infant, one year old, is reported by Mr. Bryant,[2] where a large part of one half of the tongue was covered by simple warts. They were destroyed with nitrate of silver. They may be also well treated by being thoroughly cut away.

Fairlie Clarke[3] says that "polypi" may occur upon any part of the dorsum linguæ, the usual seat being about the middle third, where the filiform papillæ are most highly developed. The same author quotes, and refers to, a number of cases of tumors of the tongue reported by different writers.

Fatty tumors of the tongue are rare, but few cases having been noted. Their general characteristics are those of fatty tumors found in other parts. Sometimes sessile, they are more often pedunculated, and vary in size from that of a hazel-nut to that of an egg.

[1] Surg. Path., vol. ii., pp. 98, 119.

[2] British Med. Journal, May 16, 1863.]

[3] American Journ. of Med. Sciences, April, 1872.]

Fibromata of the tongue are also rare. These tumors may be congenital, but more frequently develop in adults. Their situation is variable, having been sometimes found on the surface, sometimes in the substance, of the tongue. In most reported cases the disease was situated on the anterior portion of the dorsum. Dr. J. H. Pooley[1] reports the case of a young lady aged 23, from whose tongue he removed a large fibrous tumor with the écraseur. The tumor had existed for a little more than a year, was situated far back on the dorsum of the tongue, and interfered with respiration and deglutition. Frequent and severe hemorrhages occurred, due to fissures which extended through the mucous membrane covering the growth. "The tumor was as large as a bantam's egg, perfectly spherical in form, with a pedicle an inch in diameter." Superficial ulceration may occur on the surface of fibromata, but hemorrhage is not a usual accompaniment.

These solid tumors may be treated, according to their situation and form, by excision, ligature, or écraseur. The galvanocautery would recommend itself in proper cases, that is, where the tumor is pedunculated and likely to be troublesome from hemorrhage.

Besides the cold abscess, atheromatous, hydatid, and simple cysts are found on or in the tongue. Their usual situation is at the base of the tongue, where the glandular element is most abundant. While generally small, they may attain such a size as to cause great inconvenience, and even threaten life by interfering with respiration and swallowing. Cystic tumors may be treated by simple puncture, followed by injection of iodine, or they may be completely or partly excised. A portion of the cyst-wall may be cut away, and the open sac then cauterized as often as may be necessary.

Vascular tumors of the tongue may be either aneurismal or erectile. Colomb[2] describes a case of true aneurism which was situated on the dorsum of the patient's tongue, about the middle. It had the size of a "nut," was soft, circumscribed, pulsated, and increased notably when the patient spoke or made any effort. He treated it by passing a deep ligature so as to constrict the artery which entered the tumor, and another around the vessel which left it. The sac was then opened and the clots turned out. The cure was complete.

Another case is reported by John Gay, in the Lancet for 1874, vol. ii., p. 269.

A diffuse aneurism may be the result of a wound of the tongue which involves an artery. It appears as an indolent, poorly-circumscribed swelling, with a characteristic thrill. Maisonneuve treated such a case with success, by enlarging the wound and tying the vessel. One might apply pressure by means of a metallic suture passed deeply through the substance of the tongue. If these means failed, one could resort to ligature of the lingual above the hyoid bone.

Of the vascular tumors, the nævus, or erectile tumor, is the most common; usually congenital, it may appear at a period more or less remote from birth. Frequently other tumors of a similar nature are situated in the neighborhood, upon the lips, cheek, or neck. Erectile tumors of the tongue have the same anatomical peculiarities as erectile tumors situated elsewhere.

The following are the different methods of treatment which have been adopted: 1. Cauterization by means of needles heated to a white heat and thrust into the tumor. 2. Extirpation, the preferable method if the disease is superficial, circumscribed, and accessible. 3. Ligature, either single or multiple, according to the size and shape of the tumor. If the tumor be accompanied by similar growths upon neighboring parts, perhaps it is more prudent not to interfere with it, unless it be well circumscribed.

(For much of the above in regard to tumors of the tongue I am indebted to Follin and Duplay, Pathologie Externe, 1875.)]

Ranula is a fluctuating, semi-transparent, livid-blue swelling, situated under the tongue, and is commonly described as a dilatation of the duct of the submaxillary gland (Wharton's duct). Doubts are now entertained by many authors of the accuracy of this description, and Mr. Erichsen questions how so small a duct can be dilated to so large a size as is occasionally attained by these tumors. This doubt, however, disappears when one reflects upon the enormous size which the minute ducts of the mammary gland may attain in sero-cystic sarcoma.

In one case of ranula under the care of Sir W. Lawrence, the little finger could be inserted for a short distance into a cylindrical tube, pursuing the normal course towards the gland. And in another case under my care, the patient, a domestic servant, presented herself with a hard swelling near the frænum linguæ, which had been pronounced "a cancer." Upon examination, I detected in Wharton's duct one of those phosphatic concretions, about the size of a pea, common to the ducts of the salivary glands; it was removed with ease, and the patient recovered in a few days.

[1] American Journal of Med. Sciences, April, 1872.]

[2] Quoted in the Nouveau Dictionnaire de Médecine.]

But cysts may form in the floor of the mouth from any of the causes which lead to the development of cysts in other parts of the body.

Many years ago Sir W. Lawrence requested me to give him assistance in the following operation: A young lady had a swelling on the floor of the mouth. It was firmer and more solid than the common ranula. Sir W. Lawrence made an incision through the mucous membrane, and endeavored to extirpate the cyst entire; but finding it too large, he made an incision into it, and, with the handle of the scalpel, took out a quantity of thick matter, of the consistence of putty. He then removed the entire cyst, which was but loosely attached to the surrounding parts. The patient recovered.

Then we meet with other cases in which a cyst, containing a fluid of watery consistence, extends from the floor of the mouth under the sterno-mastoid muscle to the middle of the neck. Such a tumor can scarcely be regarded as an enlargement of Wharton's duct. The proper conclusion seems to be, that cysts may form in this situation from four sources. First, dilatation of Wharton's duct. Secondly, dilatation of one of the sublingual ducts. Thirdly, dilatation of a mucous follicle. Fourthly, dilatation of a bursa mucosa, said to exist on the outer surface of the genio-hyoglossus muscle. The contents of a dilated Wharton's duct are a perfectly clear and thick albuminous fluid of the consistence of white-of-egg; occasionally we meet with phosphatic concretions. An enlarged mucous follicle is filled with a putty-like substance consisting of epithelial cells filled with granular fat. An enlarged bursa, which may extend down the neck, contains a clear serous fluid, in which blood-discs may be from time to time detected in various quantities. I have no information respecting dilatation of the sublingual ducts.

The mode of treatment varies in these different forms. In the first case, the most prominent part should be seized with a pair of sharp-pointed forceps, and cut away with scissors. The interior may then be rubbed with nitrate of silver. The duct will contract to its normal size. In cases of cysts containing putty-like matter, the cyst, which is generally but loosely attached, should be dissected out entire. And in the case of the enlarged bursa, the fluid may be evacuated by a trocar, and a solution of iodine then injected; or the cyst may be traversed by a seton, so as to excite inflammation, and its subsequent obliteration. Mr. Skey employs a single silken thread passed through the floor of the mouth to the most depending part of the cyst; and I have seen benefit result from this treatment.

[It is still customary to speak of several different kinds of sublingual cysts under the general name of ranula. The custom is an unfortunate one, as it is based upon no good anatomical or pathological grounds, the origin of these different kinds of cysts being very dissimilar.

Labbé[1] divides ranulas into two general classes, namely, true, or salivary ranulas, and false ranulas.

Salivary ranulas he divides into two classes: first, those which are developed in the small glands, which together form the sublingual gland, or in their excretory ducts; and second, those which are formed by the dilatation of Wharton's duct.

Under the name of false ranula, the same author places the sanguineous, dermoid and hydatid cysts which occur in the floor of the mouth in the usual situation of the ordinary ranula. This classification is certainly as good as any that has been proposed.

It is generally conceded now, that in the large majority of cases ranula is due to the obstruction and dilatation of one or more of the excretory ducts of the sublingual gland. Such is the origin of the thin-walled, elongated, semi-transparent tumor, extending from near the frænum linguæ backwards under the edge of the tongue. With a fine probe Wharton's duct may be traced lying upon the cyst, but otherwise this duct has no connection with it.

Wharton's duct may become obstructed by a calculus, by a foreign body which has entered its orifice, or by a closure of its orifice from inflammatory action. In such a case, the duct becomes dilated so as to form a tumor, sometimes of considerable size.

A swollen condition of the submaxillary gland is then almost always noticed. The duct will also be found impermeable on using a fine probe, and saliva will not flow from its orifice as when it is unobstructed. This may be tested by applying salt to the tongue, which, when the duct is unaffected, will stimulate the flow of saliva from it.

The dermoid cyst found under the tongue has contents similar to those of dermoid cysts found in other situations. The walls are opaque, resisting, and not often fluctuating.

The sanguineous cyst found in the floor of the mouth depends for its existence on the presence of an erectile tumor. It is violet-colored,[2] diminishes in size under pressure, and increases during muscular efforts. It is formed by the rupture or

[1] Leçons de Clinique Chirurgicale, par Leon Labbé, Paris, 1876.]

[2] Labbé, op. cit.]

ulceration of a vein, the blood escaping into the tissues, or a vein may become so dilated as to form a cystic tumor.

Labbé refers to two cases of hydatid cysts presenting the appearance of ranula. In Gosselin's case, one of the two referred to, the wall of the cyst was found to be thicker than that of the ordinary ranula. The true origin of the cyst was discovered only after operation, by microscopic examination of the contents.

The ordinary ranula, which is formed by the dilation of an excretory sublingual duct, is best treated by cutting away a good piece of the wall and applying caustics or other irritating agents to the inner surface. The result to be desired in these cases is always the destruction of the secreting surface. If a small opening is made through the wall, and nothing else done, the opening will soon close and the cyst refill.

The treatment of cysts depending upon an obstruction in Wharton's duct naturally consists in the relief of the obstruction, either removing a calculus if it exists, or opening into the duct behind the obstacle. In either case the cyst empties itself through the opening made, and a permanent fistula remains, which serves the purpose of the natural opening.

According to Labbé, the best method of treating the sanguineous cyst is to make use of injections of perchloride of iron.

Dermoid and hydatid cysts require the same treatment as the common ranula, namely, free incision and removal of the contents, with such subsequent treatment of the interior of the sac as will insure an obliteration of the cavity. Of course when the size and relations of such cysts permit of their complete removal, such is the proper treatment.

Many authors state that Fleischmann's bursa frequently does not exist at all. Follin and Duplay say that when distended with fluid, this bursa forms a tumor similar to an ordinary ranula, and is to be distinguished from it only by its more median position, and by the greater thickness of the cyst wall. The treatment is the same as that of the common ranula.]

The tongue is subject to injuries of various kinds; the most common of which are those inflicted by the teeth in the convulsive fits of epilepsy. There are instances known where a portion of the organ has been completely severed by the spasmodic closure of the mouth; but the injury is rarely of a nature to require a suture. Wounds heal very readily; and a foreign body, however small, is irritating to the mouth. But a suture may, if necessary, be applied. In the Museum of Guy's Hospital there is a specimen (1974) showing a piece of tobacco-pipe embedded in the substance of the tongue; the soft parts had closed over it, so that its presence was not readily detected during life. Frequent hemorrhages ensued; and the case proved ultimately fatal. Fatal hemorrhage rarely occurs from a simple wound of the tongue. The bleeding generally ceases upon the application of ice.

Ligature of the lingual artery above the great cornu of the os hyoides in the neck, for the purpose of controlling hemorrhage from the ranine artery, is recommended, but is rarely required.

[When a foreign body has been buried for a length of time in the substance of the tongue, a small opening is always to be found, which gives vent to a variable quantity of serous, or sero-purulent fluid. If a probe is passed into this opening, the presence of the foreign body may be determined. (Follin and Duplay.)]

Syphilitic affections of the tongue are mostly ulcerative, and combined with secondary symptoms in other parts of the body. The most common sequence of symptoms is an indurated primary chancre, followed by glandular enlargement in the groin, syphilitic lepra, ulceration of the tonsils, soft palate, and tongue, and iritis. But ulceration of the tongue, as well as the other forms of constitutional syphilis, may follow any variety of primary sore. Syphilitic induration of the tongue may occur alone, in which case it has been mistaken for cancer. The diagnosis is not always easy.

A female, aged thirty, servant in a family of respectability, presented herself at the hospital, with a foul ulcer of the tongue on a hard base, situated between the middle line and the edge of the organ, midway between the base and the apex. It had existed three months; there were no other symptoms. After due consideration, it was thought that the disease was syphilitic; and she was put upon the proper remedies, namely, two grains and a half of mercury and chalk three times a day, when the ulcer healed, and the induration disappeared. We then learned that the patient had suffered from syphilis, under peculiar circumstances, which it is unnecessary here to relate.

A gentleman, aged forty-five, consulted Sir W. Lawrence with an indurated knot the size of a sixpence on the middle of the dorsum of the tongue. It had resisted common treatment, but yielded to a slight mercurial course. No other constitutional symptom of syphilis was present, and the primary sore, which was little more than an excoriation, had happened eight months before.

From the upper surface of the tongue there may project a mass of hypertrophied epithelium, which, blended together, con-

stitutes a mass analogous to the mucous tubercle commonly seen about the scrotum, the vulva, or anus. For the treatment of syphilitic affections the reader is referred to the proper section.

[The hard chancre occurs but rarely upon the tongue. According to Fournier, out of 824 cases of chancre, in only three was the sore found upon the tongue. When it exists in this situation it is found at the tip of the organ or on its lateral margin near the tip. It is always single. The ulceration is about the size of a pea, sharply circumscribed, and with an indurated base. The surface is smooth, raw, slightly elevated, and highly vascular. The lymphatic glands beneath the jaw are found enlarged.

The most common syphilitic lesion of the tongue is the mucous patch. "Their most characteristic feature is the grayish-white color, appearing as if they had been pencilled over with a crayon of nitrate of silver."[1] Mucous patches of the tongue are situated, as a rule, upon the sides or dorsum of that organ. When situated upon the sides they are most liable to become ulcerated from the irritation of teeth, pipes, etc. These ulcerations, generally multiple, are irregular in outline and covered with a characteristic white pellicle. The usual occurrence at the same time of syphilitic lesions at other parts generally renders the diagnosis easy.

Fournier[2] divides the new formations which appear in the tertiary stage of syphilis into scleroses and gummata. Sclerosis is usually developed near the median line, and always on the upper surface of the tongue, and may be superficial or deep.

Superficial sclerosis involves the mucous membrane only, produces an induration of that tissue, which may be circumscribed or diffuse, and which ulcerates only as the result of some injury or irritation.

Deep sclerosis involves the muscular as well as the mucous tissue. The induration is deep and cartilaginous. Ulceration may result, as in the superficial variety, from injuries produced by the teeth, by tobacco, or by other irritants.[3]

Gummata, which belong to late developments of syphilis, are new formations which have a strong tendency to break down and ulcerate. They may be either superficial or deep. They begin as hard nodules, usually multiple, and are always upon the upper surface of the tongue. The process of degeneration begins in the centre, and progresses rapidly till the mucous membrane is broken through, leaving deep ulcerations with sloughy walls, and surrounded by indurated borders.

The difficulty of distinguishing between tumors and ulcers of the tongue of a syphilitic nature, and those due to cancer, is often very great. The following differences are those especially noted by the authors given below :—[1]

The syphilitic lesion usually appears before the age of forty.

The cancerous after that age or late in life.

Syphilitic tumors are slow in formation, have a chronic course, and do not give rise to much pain.

Cancerous tumors steadily advance, and generally are very painful.

Gummy ulcers are usually multiple, bilateral, and are always upon the upper surface of the tongue.

Cancerous ulcers are usually single, and may occupy the under surface.

The ulceration of a gummy tumor destroys the tumor.

The induration of a cancerous tumor extends with the ulceration.

In syphilis the tongue is free and movable, speech easy and distinct, the glands rarely affected, and the ulcer never sloughs.

In cancer the tongue is much restrained in motion, speech thick, the lymphatic glands usually enlarged, and the ulcer is often sloughy, and apt to bleed.

The previous history of the patient, and the study of the behavior of the lesion under treatment, are frequently needed to complete the diagnosis.

In this connection should be mentioned a disease of the mucous membrane of the tongue, now generally known as ichthyosis (buccal psoriasis). Hulke,[2] in reporting a case of this disease says, "this affection of the tongue, to which the name ichthyosis is provisionally given, consists essentially in hypertrophy of the epithelial and papillary elements of the glossal mucous membrane." "It is characterized by tough white raised patches on the surface of the tongue; their color is not unlike that of a fine film of boiled white of egg, or wet kid leather."

"Ichthyosis of the tongue presents itself in other forms. In some cases the patches are nummular, irregularly overriding each other, and in others detached and in flakes, more or less angular, like ichthyosis of the skin. Fissures and furrows are often met with, constituting frequently small ulcers, bleeding readily, and at times such

[1 Venereal Diseases, Bumstead and Taylor, 1879, p. 588.]

[2 Sur la glossite interstitielle Syphilitique, Paris, 1876.]

[3 Venereal Diseases, Bumstead and Taylor, 1879, p. 593.]

[1 Fairlie Clarke, Diseases of the Tongue, 1873; Bumstead and Taylor, Venereal Diseases, 1879; Follin and Duplay, Pathologie Externe, Paris, 1875.]

[2 Clinical Society Reports, vol. ii., p. 1.]

excess of scales is formed that it can be scraped away in masses. The patches may extend the whole length and breadth of the tongue, on its dorsum and edges, the inferior surface being but rarely affected; the lips, cheeks, gums, and vault of the palate are likewise the seat of the affection, and in the order named, in frequency; but the fauces and tongue beyond the circumvallate papillæ are not involved."[1] While syphilitics are undoubtedly more prone than the non-syphilitic to the development of ichthyosis of tongue, numerous cases have been reported where the patients have been free from a syphilitic taint. Smokers are also more liable to this disease than non-smokers.

That persons suffering from ichthyosis of the tongue are prone to the development of epithelioma of the same organ is now generally conceded. Of sixty-eight cases studied by Weir,[1] thirty-five resulted in epithelioma.

A very interesting case showing this tendency to the development of epithelioma is related by Mr. George Brown in the Clinical Society's Transactions, vols. x. and xi. In the early stage of this disease, if the patches are sufficiently limited in area, excision is undoubtedly the best treatment.[2] If the disease is too extensive to admit of excision, little can be done beyond removing sources of irritation, such as jagged teeth, and interdicting smoking. Local applications are of no value except for the treatment of fissures or secondary ulcerations.]

Cancer, as it affects the tongue, usually occurs in one of two forms: either interstitial deposit, when it is called scirrhus; or more superficial development, when it is called epithelial cancer, or epithelioma. Both forms are of serious nature. I have not hitherto known any well-recognized case in which, even after the most complete and early removal, the cure has been permanent. In both instances microscopic investigation detects the usual elements of cancer, namely, nucleated cells and connective tissue.

[It is now believed that cancer affecting the tongue occurs in only one form, namely, epithelioma.[3] It may be either superficial or deep, and it is the deep or interstitial variety which used formerly to be called "scirrhus."

The starting point of superficial epithelioma is often a warty growth, a nævus, or a patch of ichthyosis. Hypertrophy of the papillary element of the mucous membrane is a phenomenon common to ordinary papillary growths and to superficial epithelioma; but in epithelioma new cells which invade the whole thickness of the mucous membrane are developed, and the papillæ themselves become misshapen. It may be impossible to tell for some time whether a mass of hypertrophied epithelium upon the surface of the tongue is a simple hypertrophy, or is destined to steadily develop into a true epithelioma. The difference is first noted when the whole thickness of the mucous membrane is involved, and the new formation begins to extend into the tissues beneath. An indurated base is then rapidly formed, and the surface of the vegetation takes on characteristic changes. The epithelioma becoming yellow and hard is exfoliated, fissures appear upon the surface, which run together and form true ulcerations, and gradually a characteristic induration is produced by the invasion of the deeper tissues.

Deep epithelioma commences in the substance of the tongue, the mucous membrane being often at first quite unaffected. It may be recognized then as a firm indurated swelling. Formerly called scirrhous cancer of the tongue, this form of the disease has been found to consist of the same epithelial structure as the superficial variety, with a large addition of new-formed connective tissue.

The morbid products force themselves like shoots into the muscular substance, and even follow the vessels for some distance. The bloodvessels themselves are often attacked; hence the bleeding, which, after ulceration, frequently occurs, and invasion of the lymph-vessels precedes the disease of the lymphatic glands which is so sure to follow in time.

As the tumor grows, the mucous membrane (generally though not always) becomes involved and destroyed, and an open ulcer is formed from which flows a purulent fluid full of broken-up diseased cells. This ulceration often appears to start in a crack or wound of the tongue, and very frequently is attributed to the injury caused by a jagged tooth. But in all cases, where true epithelioma exists, an indurated base to the ulceration is found.

Superficial epithelioma is formed chiefly on the upper surface of the tongue near the tip; in a few cases it has been noted on the under surface near the frænum.[1]

The favorite position for the deep variety is the border of the tongue, rarely near the tip, and not infrequently as far back as the tonsil.

[1 Weir, N. Y. Medical Journal, March, 1875.]

[2 Fairlie Clarke, Lancet, 1874, p. 369.]

[3 O. Weber, Pitha und Billroth, Chirurgie; Aug. Rigal, Nouveau Dictionnaire de Médecine.]

[1 Du Cancer de la langue, Théophile Anger, Paris, 1872.]

The ulcer of epithelioma has often characteristics which enable one to decide upon its nature readily, but it may be extremely difficult to make a positive diagnosis as to whether it be tuberculous, syphilitic, or cancerous. The age of the patient, the painful nature of the lesion, particularly the pain extending towards the ear, the sloughing, readily-bleeding surface, which is often covered with vegetations, the restrained motion of the tongue, the rapid growth with constantly extending induration, and the involvement of lymphatic glands, may enable one to form a positive opinion. But perhaps it is not too much to say, that in all cases, before an operation is undertaken, a portion of the diseased tissue should be submitted to a microscopic examination.

According to the statistics of T. Anger,[1] epithelioma of the tongue is five times more frequent in men than in women. It rarely occurs before the age of forty, and is most common between the ages of fifty and seventy.]

We have first to inquire what is the cause of cancer of the tongue. Is it due to local irritation, such as is excited by an irregular or broken tooth? If such were the case, how infinitely more common should it be! how frequently should we notice its ravages in the mouth! Many experienced dental surgeons deny that irregularities in the shape of the teeth will do more than determine the exact seat of development of cancer in constitutions previously so disposed; and the same may be said of the irritation excited in other ways. Let us take, for example, the irritation produced by a clay-pipe. How many are there who smoke unaffected by cancerous disease to the end of a long life! How often have we to remove carcinomatous or cancerous growths from the mouths of persons who have rarely or even never smoked at all!

I lately extirpated such a tumor from a man aged seventy. He had lived a most abstemious life, and had rarely indulged in any luxury, however humble. The wound of the tongue cicatrized; but the patient died eight months afterwards of secondary disease in the glands of the neck.

Still the irritation excited by the constant presence of a tobacco-pipe cannot be ignored. In 1848 I examined the body of Major-Gen. D., aged sixty-three, a patient under the care of Sir W. Lawrence, who gave me the following history of the case: This officer had been above thirty years in India, where he had lived freely. He was always in the habit of smoking a short clay-pipe, the end of which he kept firmly wedged between the floor of the mouth and the under surface of the tongue. About July, 1847, he noticed a slight impediment to swallowing; the food, as he said, was caught in its passage through the fauces. A physician applied caustic, but without avail; the disease increased, and the left side of the tongue became swelled and hard. The patient died June 19th, 1848, without particular suffering, and rather from exhaustion than from suffocation. On examination after death, a deep ulcer was found, the size of a shilling, with red and raised edges, on the left side of the under surface of the tongue. It perforated the root of the organ, and spread on the dorsum into an ulcer three inches broad and two inches from before backwards, in which direction it involved the soft palate and tonsils, and had destroyed the epiglottis and the aryteno-epiglottidean folds. The aperture of the glottis was nearly blocked up, and disease spread into the interior of the larynx. There had been little or no hemorrhage during life. There were six or seven small absorbent glands, infiltrated by masses of opaque yellowish-white matter. The morbid growth consisted of epithelial cells, and similar bodies were embedded in the tongue along the course of the penetrating ulcer. This gentleman's father had lived to a very advanced age.

Hard cancer or scirrhus of the tongue commences as a firm and incompressible knob on the edge of the organ, situated often opposite the last molar or wisdom tooth; or so far towards the root that it is often beyond the reach of surgical interference. The patient at first complains that the tongue is sore, and he often attributes this symptom to the irritation of an unsound tooth, and to the uncontrolled movements of the jaw during sleep. Soon the act of deglutition becomes painful: the patient fears either to eat or drink; a sharp pain extends along the Eustachian tube towards the ear; the saliva flows from the mouth profusely. The symptoms become aggravated during sleep; the nights are disturbed by the secretion accumulating in the throat and exciting cough. Often the patient is roused by a painful compression of the tongue between the jaws; and as the ulceration extends, hemorrhages occasionally supervene. Sooner or later the submaxillary absorbent glands become enlarged by the same cancerous deposit, when first a circumscribed and then a diffused tumor forms in the neck, covered by thin and reddened integument, which, should the patient survive a sufficient length of time, ulcerates, leaving a foul open sore, discharging a thin fetid fluid, with occasional hemorrhages. But with the progress of the disease emaciation supervenes, and the patient dies with the usual cachectic indications of cancer.

But this is not the only form of malig-lignant disease affecting the tongue.

[1] Du Cancer de la langue, Théophile Anger, Paris, 1872.]

In 1847, Mr. Ceely, of Aylesbury, removed from the tongue of a patient a soft, friable, and irregularly-lobulated mass of reddish-brown color, with vascular red points, but without any distinct arrangement of vessels, composed of caudate or club-shaped cells with large nuclei, blood-discs, and a thickish matter coagulable in alcohol. The tumor, said Mr. Ceely, when examining it immediately before its removal, protruded from the mouth; the tongue was thrust to the left side, and was swollen; the lips were œdematous; the surface of the tumor was in many places black, and a sero-sanguineous fluid oozed from its upper part. By retracting the angles of the mouth, and directing the patient to thrust the tongue forward, and at the same time raising the tumor over the lower lip, it was brought so far forward as to become girt round its broad base by the whole circumference of the mouth, where it remained fixed. It then felt quite elastic, and measured longitudinally five inches, transversely three inches. While it was in the above situation, I placed my fingers, continued Mr. Ceely, under the tumor, and gently raising it from the base I peeled it off, when a large jagged surface was left, which was soon covered with coagula from bleeding vessels. The hemorrhage was moderate, and easily repressed with the matico-leaf in coarse powder. The portion removed very much resembled recently detached placenta, though perhaps less firm; it was a spongy, granular mass, with interstitial fluid blood; it had none of the shaggy filamentous appearance of cauliflower excrescence detached from the uterus. The weight of the mass removed was seventeen drachms and a half. On April 8th, 1860, Mr. Ceely reported that the man was still alive, although the morbid growth was reproduced within a week.

I saw near to town, in 1848, a patient in whom there was scarcely any vestige of tongue remaining, the whole organ having been affected with a similar friable degeneration. The patient could still articulate, and suffered less than might have been expected.

In 1860, a patient under the care of Mr. Harle, surgeon, of Islington, presented himself at the hospital, in whom a portion of the upper surface of the tongue, the size of a six-penny-piece, was occupied by an opaque white layer or mass, consisting of thickened epithelium, rising above the level of the surrounding parts. Under the microscope the substance was seen to consist of epithelial scales, dried and deformed, and containing but few nuclei. There was no tendency to indefinite propagation, as in cancer, nor to any implication of the neighboring tissues. The papillæ under the white mass seemed enlarged. There was no swelling of the neighboring absorbent glands. The disease had existed twelve years without material change; the patient was a healthy woman aged forty, and no surgical interference was indicated. But when this white mass was raised, and the state of the papillæ seen beneath, the resemblance to epithelioma was obvious. And it was found, by microscopic examination, that the softer epithelial cells carried out this resemblance further. That the disease was not of cancerous nature was proved by the history; no source of local irritation was discovered by the most careful examination; and the case served to illustrate the fact that in malignant disease there is something beyond the mere increase of the epithelial elements.—It was in all probability of this character that a tumor, called supposed epithelioma of the tongue, partook, which was presented to the Pathological Society, December 6th, 1859.[1] It was taken from a patient aged seventy-nine; had existed sixteen years, and had been six years under observation. It involved the tip, the right half and the left side of the tongue; the pharynx and larynx were atrophied. After death, an examination of the body was made, when no malignant disease was found elsewhere.—In 1857, I saw a similar case under the care of Mr. Ceely, of Aylesbury. The patient was a sailor, of very intemperate habits; and about fifteen years ago he presented himself with a small epithelial growth on the tongue about the size of an almond.

A cancerous tumor of the tongue should be extirpated, when possible, by the knife. The patient must sit in a chair, with the head supported: chloroform [or ether] had better not be given in simple cases, because the concurrence of the patient is needed. An assistant grasps the tip of the tongue, covered with a towel, between the forefinger and thumb of one hand, while with the other he pulls back the cheek. The surgeon then seizes the tumor *completely* within the blades of double-hooked forceps, and with a sharp round-pointed knife, of somewhat large size, sweeps away the enclosed mass in a few seconds. The whole tumor must be grasped with the forceps, that none be left behind. The hemorrhage renders any subsequent examination troublesome. The knife should be round-pointed, that none of the arteries on the floor of the mouth be wounded. It may be curved in different ways, according to the fancy of the operator; but a straight knife is always the best. The hemorrhage must be controlled by ice [or hot water]. An artery which commonly needs a ligature is the sublingual; and this can only be wounded by the surgeon using a sharp-pointed knife. No ligatures or sutures are usually desirable to the wounded tongue; they irritate the mouth, and excite the flow of saliva. The cut surfaces granulate and heal, leaving perhaps an elevation of the substance of the tongue, from its being puckered up at the seat of operation. This, however, can be distinguished from the reproduction of disease, by the absence of induration.

The écraseur has supporters as a proper instrument for the performance of these

[1] Path. Soc. Trans., vol. xi., p. 240.

operations. When both lingual arteries may be divided, it is to be preferred to the knife, and M. Chassaignac has amputated the tongue close to its base with this instrument. As the disease threatened to involve the entire organ, its complete extirpation was resolved on. Two or three days before undertaking the operation, M. Chassaignac passed a drainage-tube from without round about the base of the tongue, immediately above the great cornu of the os hyoides. The point where the tube was introduced was a little to the right of the middle line. Having thus prepared a passage for the chain of the écraseur, the tube was withdrawn as soon as the chain was in position. Then commenced the separation of the organ. Two minutes were allowed to elapse between each movement of the instrument; and the transverse division of the organ was effected in exactly half an hour. The chain was then passed behind the base of the separated organ, and made to embrace the muscles and tissues attached to its under surface. In thirty minutes more this second part of the operation was completed, so that the entire time occupied was exactly one hour. The quantity of blood lost was quite insignificant, and the poor man did not evince great suffering. On the eighth day after the operation he was going on well.[1] A subsequent account reports the patient's recovery. A yet more serious and complicated proceeding consists in the introduction of the chain round the root of the tongue by means of an incision into the floor of the mouth from without. A second chain is required to free the severed tongue from the muscles and soft parts; this double operation takes about one hour for its completion. The jaw has been divided at the symphysis and the two halves pulled asunder in order that the surgeon might gain more room for passing the chain down to the root of the organ. But the amount of space thus obtained does not equal the surgeon's expectations.

When the cancerous degeneration is limited to the side of the tongue, no such proceeding can be necessary, for the severed arteries are but small. But when the operation involves an extension beyond the mesial line, so that one or both ranine arteries must be cut across, and that, too, towards the base of the organ —under such circumstances the écraseur may be used with advantage. With it may be combined the employment of the ligature, as in the following case.

In 1859, I removed by the knife a cancerous mass from the left side of the tongue of a man aged forty-two. The hemorrhage was considerable, the wound being very deep; but it ceased after the prolonged use of ice. The parts cicatrized completely, and the patient left the hospital apparently well. In ten months the disease returned in the cicatrix, and the patient came to me with the request that I would again remove the hardened parts, in order to give him even temporary relief from pain. As the induration extended quite to the mesial line, and the ranine arteries would of necessity be divided, I proceeded as follows:—

Chloroform having been administered so as to produce complete insensibility, the tongue was drawn from the mouth by an assistant; the chain of a small écraseur, armed with a needle, was then passed through the middle of the tongue beyond the base of the tumor, and made to cut from within outwards, so as to sever the posterior connections. Next a slight incision was made with scissors into the point of the tongue, so as to guide a ligature round the remaining attachment of the partially severed mass. A strong knot was tied, the prominent part cut away, and the patient was removed to bed.

In December, 1861, Mr. Nunneley described, before the Royal Medical and Chirurgical Society, the particulars of an operation for the complete extirpation of the tongue, in which it was asserted the cure had been permanent for some months. A small incision was made anterior to the os hyoides through the integument, mylohyoid, and geniohyoid muscles, by which a curved needle, to which was attached the chain of the écraseur, was introduced so as to carry the chain completely round the base of the organ. In consequence of some imperfection in the chain, it was removed; strong whipcord was substituted, and tied with all the force possible. During the course of treatment hemorrhage supervened, but it was easily arrested by a solution of tannin. Ultimately the organ came away, and the wound cicatrized. Some doubt, however, was expressed by the Society as to the exact nature of the disease.[1]

The tongue has been completely extirpated by the knife. Regnoli has removed large portions by making an incision into the floor of the mouth from one angle of the inferior maxilla to the other. But Mr. Syme first, and subsequently Mr. Fiddes,[2] have extirpated the entire organ, by making an incision through the lower lip, chin, and lower jaw, pulling aside the two halves of the bone, and dissecting the diseased mass, which is by these means fully exposed, from the os hyoides. Mr. Fiddes points out the importance of securing one lingual artery before the other is divided. He has operated thus twice, and

[1] Med. Times and Gazette, May 14, 1859.

[1] Med. Times and Gazette, Dec. 21, 1861, p. 648.

[2] Edin. Med. Journal, June, 1859.

speaks well of the results of his cases. The proceeding has not, however, yet found favor generally with modern surgeons.

Now, in cancer of the tongue the greatest distress to the patient arises, first from the pain in every movement of the organ, extending to the ear and over the side of the head; and secondly, from the profuse flow of saliva, which keeps him constantly wet and unable to articulate with comfort. The idea of diminishing the sensibility of the tongue, and of checking the excessive secretion by the division of the gustatory nerve as it lies close to the ramus of the jaw, suggested itself many years ago to Mr. Hilton;[1] and Mr. Moore, of the Middlesex Hospital, has recently repeated the operation.[2] By dividing the gustatory nerve, he remarks, between the disease and the brain, all the consequences of the irritation of that nerve are necessarily suspended. No sensation from the tumor can be conveyed along it; no reflected irritation can reach the collateral branches of the fifth nerve; no stimulus to an exaggerated secretion of saliva can be given to the salivary glands. A patient on whom this operation has been performed should speak more freely, and swallow with less difficulty; should be relieved of pain in the tongue and jaw, temple, and crown of the head, and of the incessant annoyance arising from the dribbling of saliva; he should sleep better, and be better nourished than before.

The mode of performing the operation, as adopted by Mr. Moore, differs in some respects from that adopted by Mr. Hilton. The latter surgeon sought for the nerve in the floor of the mouth, and exposed it by making an incision along the mucous membrane close to the sublingual gland. The former divides the nerve just behind the last molar tooth, as it escapes from the cover of the pterygoideus internal muscle. It is not more than half an inch distant from the tooth, and is covered only by mucous membrane.

The guide to the nerve is the last molar tooth. On passing the finger into the mouth, within and beyond that tooth, the bulging alveolar ridge can be felt narrowing as it ascends into the thin ramus. Behind, below, and parallel with the ridge, is a shallow groove in the bone. The nerve passes along that groove. Therefore an incision three-quarters of an inch in length made within the mouth and down to the lower jaw behind the last molar tooth, and in a direction crossing the course of the nerve, must divide it. It is advisable to operate with a curved bistoury, since the alveolar ridge might shield the nerve.

The patients have expressed themselves relieved; the tongue being rendered completely numb.

Mr. Moore has combined with this operation ligature of the corresponding lingual artery, so as to cut off as much as possible the supply of the blood to the affected part. The results are sufficiently encouraging to merit further trial.

It must be remembered, however, that there are ulcers of the tongue of very unfavorable aspect, which are not cancerous.

A patient, aged thirty-seven, had an ulcer of the tongue of eight months' duration. It was situated on the right half of the tongue, and had a coarsely granulated base, with inverted edges and undermined margin exposing the muscular tissue. The patient died laboring under severe tubercular disease of the lungs, and after death there were found tuberculous deposits both in these organs and in the larynx, but no trace of cancerous disease.[1]

The rule, therefore, holds good that in cases of doubtful ulceration of the tongue, all sources of irritation, such as the sharp edge of a decayed tooth, etc., should be removed, and great attention should be paid to the general health before we arrive at a final diagnosis.

[At the present day anæsthetics are universally given in operations upon the tongue. To say nothing of the avoidance of pain by their use, the great advantage is gained of having the muscular fibre of the tongue entirely relaxed. Whether the patient be lying down or sitting up is a matter of choice, but most operators prefer to have the patient lying upon the operating table, with the head and shoulders raised. The best method of controlling the tongue, is to pass one or more stout ligatures through the organ, at a point where they will not be severed by the instrument used in operating. The free ends of the ligatures being then tied together, the tongue can be held in any desired position by dragging upon the loops. If hemorrhage occurs from any vessel of size, it is best to apply a ligature to it at once. Small vessels, or a general oozing, can usually be controlled permanently by firm pressure maintained for a few moments with sponges packed against the bleeding surface. If small vessels continue to bleed when the pressure is removed, they may be easily twisted, or the point of a cautery, such as Pacquelin's, may be applied to them. Whatever instrument is used to remove portions of the tongue on account of malignant disease, should be so used that the section of tissue be made *at least* one-half inch behind or free of the disease. Epitheli-

[1] Guy's Hospital Reports, vol. vii., p. 263.
[2] Med.-Chir. Trans., vol. xlv., p. 47.

[1] The preparation is preserved in the Museum of St. Bartholomew's Hospital.

oma often prolongs itself in the substance of the affected organ for some distance beyond the superficial limit of the disease. When the cut surface is in such a condition that it can be properly examined, search should always be made to ascertain if a sufficient amount of tissue has been removed. Malignant disease only partially removed is prone to spread with increased rapidity. Sutures may be very desirable after operative as well as after accidental wounds of the tongue. Of course, they are of no use when the galvano-caustic wire has been used, but when clean incisions have been made, as when V-shaped portions have been removed, there is a great advantage in obtaining early union. In Billroth's cases, referred to under the head Tuberculous Ulcer, sutures were used, and union took place in from three to five days.

Syme's operation of dividing the jaw at the symphysis was designed to permit of more ready access to the cavity of the mouth. It has been proved, however, as can readily be demonstrated upon the cadaver, not to facilitate the access to a diseased tongue nearly as much as might be expected.

Sédillot modified the section of the jaw referred to, by making it <-shaped, so as to prevent the slipping of one-half of the jaw upon the other, after the parts are brought together. To attain the same object, namely, to enlarge the entrance to the mouth, Collis, of Dublin, advised splitting of the cheek from one angle outwards towards the masseter muscle. This method undoubtedly renders it much easier to get at diseased parts situated far back in the mouth.

Billroth's operation, devised to permit thorough removal of disease affecting the under surface of the tongue and the floor of the mouth, is performed as follows :—

A horizontal incision is made three centimetres below the free border of the lower lip and extending from one facial artery to the other. From either end of this, a vertical incision is made extending to a point two centimetres below the lower border of the jaw, and deep enough to expose the bone. The bone is divided on both sides by means of a chain saw, in the line of the vertical section of the soft parts, holes having been previously bored to permit of the use of metallic sutures when the bone is replaced. The fragment of bone included between the saw-cuts, together with the soft parts superficial to it, can then be thrown down on the neck, and free access to the floor of the mouth obtained.

Prof. Kocher, of Berne, has recently published[1] an account of a new method of exposing the tongue with a view to its partial or complete removal in cases of malignant disease, and the results which he has achieved as regards prolonged immunity from a return of the disease, are quite unequalled. Kocher's method is, briefly described, the following :—

An incision is made from the level of the angle of the jaw downwards along the anterior edge of the sterno-cleido-mastoid muscle as far as its middle. From this point an incision is made transversely forwards to the body of the hyoid bone, and then upwards along the anterior belly of the digastric to the maxilla. A triangular flap is thus marked out which is lifted and thrown upwards upon the face. All the lymphatic glands, the sub-maxillary gland, and often the sublingual, are removed completely. The facial vein, and facial and lingual arteries, are tied and divided. The mucous membrane of the floor of the mouth is then incised along the lower jaw, together with more or less of the mylo-hyoid muscle. The entire side of the tongue, from apex to base, can now be reached, and a portion or the whole of it removed by any of the usual methods. Kocher lays great stress upon the importance of a preliminary tracheotomy, and he prefers to tampon the lower part of the pharynx with a sponge, rather than use Trendelenburg's balloon tampon in the trachea.

In his cases no attempt was made to secure early closure of the large wound made in the neck. On the contrary, no stitches were used ; the wound was always kept open and dressed antiseptically. The patient was fed twice daily by the œsophageal tube introduced through the wound under the carbolic acid spray. The sponge tampon in the pharynx was removed each time the patient was fed, the sponge being soaked in a five per cent. solution of carbolic acid, wrung out in water, and then replaced.

Boyer's method of using the knife or scissors, may be advantageously employed in cases where the portion of tongue to be removed is situated in front. It consists in making a V-shaped section through the whole thickness of the tongue, the point of the V being directed backwards. The flaps left are then brought together with sutures, leaving a stump more nearly approaching in shape a normal tongue, than by the simple method of operating already described. This method has been made use of with complete success in removing a mass of hypertrophied tongue.

The scissors may be conveniently used in extirpating small portions, or even the whole of the tongue. Mr. Lund, of Manchester, has recently published an account of this method as practised by Mr. White-

[1 Deutsche Zeitschrift für Chirurgie, 1880.]

head. He states that the entire tongue has been frequently and successfully removed by Mr. Whitehead and by himself, the only cutting instrument used being a pair of scissors.

Bryant, in his Practice of Surgery, says: "When the galvanic écraseur, or écraseur wire heated by the galvanic battery, can be obtained, no better means can be found for removing small or large portions of the tongue, and since I have employed them, I have given up excision." The galvanic écraseur may be used in any case if some cautions are observed. The wire may be placed so as to cut in any direction, by the use of a curved needle armed with a ligature, passed through or around the tongue, the wire being drawn after. The anterior half of the tongue can be easily brought entirely out of the mouth, by employing Mr. Paget's method of first dividing all the attachments of the tongue at its under surface. It is very important that the wire used should be of large size, and heated only to a red heat, otherwise the cutting will be too rapid, and hemorrhage will not be avoided. The loop should also be narrowed very slowly, that the action of the hot wire may be more a burning than a cutting one. To prevent the loop from dividing obliquely, or from gradually slipping forward as it is narrowed, two or more stout pins should be passed through the tongue well behind the disease. The loop of wire being adjusted behind the pins, the desired line of section can be preserved.

Whatever instrument is used in extirpating the whole, or a portion of the tongue, hemorrhage may occur to a troublesome and even dangerous extent. Hemorrhage may be dangerous from the quantity of blood lost, or from its passage down the trachea. The difficulty and inconvenience of managing anæsthetics given in the ordinary way during operations upon the mouth, nose, or pharynx are constantly seen, and the inhalation of air which first passes through a cavity partially lined with putrid material is evidently injurious.

These dangers and difficulties may be overcome by the performance of a preliminary tracheotomy. This operation has been frequently done as a preliminary to operations about the upper air passages, and the value of it, in extensive operations upon the tongue, has been shown by Mr. Arthur T. Barker, who reports several cases in the Lancet for August 23, 1879. To avoid the risk of having blood pass down the trachea, Trendelenburg's tamponing canula may be used, or an ordinary tracheotomy tube, and the anæsthetic can then be given through the canula. If an ordinary tube is used, the lower part of the pharynx should be tamponed with a well-fitting sponge, pushed down through the mouth, the precaution having been taken to have a long ligature attached to the sponge, by which it may be removed.

Trendelenburg's apparatus for holding the ether, and conducting the vapor to the canula, is invaluable. After the operation the mouth may be drained by means of a tube passed through its floor, the nostrils plugged, and the mouth closed. The patient will breathe only pure air through the canula. I cannot but think that this preliminary operation will constantly grow in favor.

As a preliminary operation, one or both lingual arteries have been tied just over the hyoid bone. This is, of course, the most certain method of preventing hemorrhage during the subsequent operation upon the tongue itself. That this is a necessary step is certainly not true, as is shown by the success with which the tongue has been removed and the arteries tied on the stump.

Still another method of preventing hemorrhage in operations upon the anterior portion of the tongue has been devised by Langenbeck.[1] His plan is to place a temporary ligature upon the tongue in such a manner as to include the lingual arteries.

The point of a curved needle, armed with a strong ligature, is entered on the dorsum of the tongue, behind the line of the proposed section, and a little to one side of the median line. The needle passes downwards through the tongue beneath the lingual artery of the opposite side. It is then brought into the mouth through the floor at the side of the tongue, and is brought out on the dorsum again. The two ends of the ligature being then tied tightly together, the substance of one half of the tongue, including the lingual artery of that side, is firmly compressed. A second ligature is passed so as to include the other half of the tongue and the other lingual artery.

No hemorrhage can take place during an operation on that part of the tongue which is in front of the ligatures. The wound made in removing the disease having been carefully stitched, the temporary ligatures are cut and pulled out.]

[1] Langenbeck's Archiv, vol. xxii.

PART II.

DISEASES OF THE CIRCULATORY SYSTEM.

DISEASES OF THE VEINS.

DISEASES OF THE ARTERIES.

ANEURISM.

DISEASES OF THE ABSORBENTS.

PART II.

DISEASES OF THE CIRCULATORY SYSTEM.

DISEASES OF THE VEINS.

By G. W. Callender, Esq.

Revised by Lewis A. Stimson, M.D.

John Hunter was the first to describe inflammation of the lining membrane of veins.[1] Aretæus[2] had long before referred to some such disorder; but the disease he told of was so ill defined, that no one profited by or sought to advance his crude idea. Century after century surgeons continued to puncture, divide, and excise veins, fearless of the result and innocent of their inflammation. Troublesome symptoms, it is true, sometimes followed these operations; but they were referred to nerves, tendons, or fasciæ—anything rather than the veins—to nerves more especially.

"I was called in haste," says Ambroise Paré, "to see his Majesty.[3] He had been let blood by a surgeon, and a nerve had been wounded in performing the operation, at which the king cried out with pain. The arm became contracted, and the pain diffused throughout the entire limb. I applied a plaster over the wound to assure its closing, and bathed the part with warm turpentine and spirits of wine to allay the irritation, the arm being bandaged to the shoulder, and after a time the symptoms began to abate."

Gangrene, he further states, may attack an arm after venesection, and may prove mortal. "I have known a lady to die," writes Dionis, "from diffused inflammation of the limb after a bleeding from the foot."

Paré, treating of varices,[1] observes: "sometimes in the limbs they contain a thrombus of blood, dry and hard, which, the vein being opened, should be evacuated." Petit writes a description of the formation of clots in obstructed veins, and of some of the changes they subsequently undergo.[2] Discussion was held respecting other clots or polypi (*polypes veineux*), as they were termed, which were found in the heart; and between Haller, Morgagni, and A. and J. Pasta, opinions differed as to the manner and time of their formation.[3] Langswert wrote "de inflammatione venarum" in the section of his work, De Morbis Arteriarum et Venarum compositis,[4] but beyond the suggestive name made

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[1] Phlebitis, so named by Breschet, from the word φλέψ (φλεβός), which was employed by Hippocrates to designate the channels which conveyed fluids, the term artery having reference to the air-passage alone. Thus, under the name of veins were included the various secretory canals, as the bile-ducts and the ureters; and hence Celsus wrote "a renibus singulæ *venæ*, colore albo, ad vesicam feruntur: οὐρητῆρας Græci vocant" (De Re Medicâ, lib. iv.). Praxagoras first distinguished veins from arteries; for Aristotle, though he gave the name of aorta to the vessel which still bears that title, continued to write of it as one of the veins. See Galen de Hip. et Platonis Dogmatibus, lib. vi., c. 10; Galen de dignoscendis Pulsibus, lib. iv., c. 2; Le Système veineux, par le Docteur Verneuil, Paris, 1853.

[2] Κεφ. ἡ περὶ τῆς κατὰ τὴν κοίλην φλέβα ὀξείης νούσου. Sydenham edition, London, 1856.

[3] Charles IX. of France.

[1] Œuvres complètes d'Ambroise Paré, par J. F. Malgaigne, tome ii., pp. 268 et seq.

[2] Sitôt que le tronc des vaisseaux est entièrement bouché par le premier caillot, le sang qui remonte par les branches se coagule à mesure qu'il arrive, la tumeur augmente et devient plus dure." He then describes softening of the tumor thus indurated, which he ascribes to separation of serum from the clot: "c'est cette sérosité qui fait la mollesse." Traité des Maladies chir., tome ii., p. 42.

[3] J. Pasta, De sanguineis Concretionibus, Bergami, 1786.

[4] Pragæ, 1763.

no advance upon the subject. Attention, however, had been thus drawn to the ill consequences which occasionally followed wounds of veins, and the formation of clots in their canals was recognized in connection with varices and with obstruction.

Meckel, Frank, and Sasse followed Hunter in describing inflammation of the inner coat of veins; and from their time this disease (divided into the adhesive and the suppurative) has been amply illustrated by numerous observers, and by none more clearly than by Gendrin, who thus describes its morbid anatomy.[1]

He finds the inner tunic of an inflamed vein at first of a more or less deep red color; but the evidence derived from this condition is often valueless from the attendant blood-staining. On separating the inner coat from the middle, which can be done more easily than in the healthy state, the injected capillaries become evident, even in the structure connecting the inner with the middle coat. After a while the inner coat becomes uniformly red, and is less transparent, so that vessels beneath are no longer distinguished. It has lost its polish, and even has become somewhat rough. It acquires, if the disease progresses, a swollen and villous appearance, and, but for its easily tearing, can be readily detached from the middle coat. The latter quickly thickens, so that the vessel resembles an artery, but is less resisting. The external coat is also affected and infiltrated with serum or blood. The cellular sheath becomes involved, so that the whole forms a blended blood-stained mass. A membrane sometimes lines the vessel, of little consistence, forming a cheesy pulp when pressed between the fingers.

Ribes, however, has observed this membrane firm and resisting, and even organized, though but slightly adherent to the adjacent wall. Sometimes it adheres so firmly that it cannot be completely detached, and it occasionally covers a great extent of vein-wall, as in a case described by Chaussier,[2] in which the left renal and adjacent veins were thus coated. The blood now forms on the wall of the vessel fibrinous clots, more or less decolorized, by which the tube becomes blocked up. These clots are not formed at once, but "fresh fibrinous layers are continually being added, and in a proportionately very short time a plug is formed which fills the entire calibre of the vein."

"This fibrinous coagulum extends both above and below, far beyond the limits of the portion originally inflamed; the plug, however, ceasing by degrees to be made up of concentric layers, gradually passes into a tapering coagulum, more or less tinged with the color of the blood, and little, if at all, adherent to the walls of the vessel. In all the branches of veins which immediately lead to the plugged portion, save those which have other channels by anastomosis, the blood stagnates and coagulates. The plug is shorter above, and seldom extends beyond the point of junction with the nearest venous trunk."[1]

Such is an account of changes which are said to accompany adhesive inflammation of veins. In a word, their inner and middle coats become inflamed, lymph is exuded upon and clings to the surface next the blood, the latter coagulates, and so the vein is filled partly with lymph and partly with clots. Then, as in every other inflammation, the mingled products undergo further changes.

It is, however, difficult to receive these statements in the face of facts which throw doubt upon the existence of an adhesive phlebitis. First, be careful, suggests Ribes, to distinguish all this redness of the lining membrane of veins from post-mortem congestion. Veins, after death, quickly become stained by the fluids adjacent, more rapidly in some cases than in others. Their discoloration is uniform, and, especially in small vessels, extends to the surrounding tissue, and this more particularly in the dependent parts "in inflammatory subjects from the ready separation of decolorized fibrinous concretions, in others from disseverance of the corpuscles."[2] Many have been misled by this discoloration, easy as its recognition may appear; for example, those who regarded phlebitis as the principal seat of erysipelas; and Ribes himself, when he wrote of an inflammation involving the roots of the portal vein of all persons dying with adynamic fever. Those also who assert that they have seen a phlebitis extending through many veins until it reached the heart, are equally deceived by this post-mortem staining.

The experience of Guthrie,[3] who doubts the existence of an adhesive, or as he terms it, a healthy inflammation of veins, is opposed to Gendrin's description; and Travers,[4] whose statements, by the way, are contradicted by Bichat,[5] concludes that "the internal coat of a vein is, when compared with an artery, difficultly susceptible of adhesive inflammation. Indeed, the process of healing and division

[1] Histoire anatomique des Inflammations, tome ii., p. 16.

[2] Revue méd. française et étrangère, 1825, tome iii., p. 9.

[1] Hasse's Path. Anatomy, English trans., p. 14.

[2] Gendrin, op. cit., tome ii., p. 5; Ribes, Revue méd. française et étrangère, tome iii., p. 5. 1825.

[3] A Treatise on Gunshot Wounds, 3d edit., p. 299.

[4] Surgical Essays, part i., p. 255.

[5] Anatomie pathologique, dernier cours, chap. xiv., p. 266.

by ulceration seems to be conducted without any sign of inflammatory action; but the indisposition of the venous membrane to inflame is not, as appears to me, inconsistent with its tendency, under adequate excitement, to inordinate and excessive inflammation. It is not unusual to find the morbid action of parts that are difficultly roused least controllable when once set up." Frank and Sasse saw matters very differently. They observed a deep redness of the internal coat diffused throughout the vessel, and after ligature "a sort of false membrane, resulting from the inflammatory action."[1]

Cruveilhier[2] observed that vascularity was not seen in the lining membrane of veins, even when the blood charged with irritants from inflamed parts caused an inflammation; for "I do not regard the phlebitis as the first change, but consider the coagulation as anterior to the phlebitis." Hunter[3] thought it difficult to conceive "how adhesions should take place on the internal surface of veins; since it is most obvious that the coagulable lymph thrown out by the exhalants on the internal surface of the vein, mixing with the same fluid circulating with the other parts of the blood, would be swept away without producing any effect. But since such adhesions do in fact happen, the coagulable lymph must undergo some change connected with the disposition which produces its extravasation."

Travers was the first to show that veins after ligature or division, repair without an adhesive inflammation. Three preparations illustrate this fact. One, in the museum of St. Thomas's Hospital,[4] is thus described, "Appearance of a vein divided by the ligature, which came away on the twenty-fifth day. The upper part of the vein is filled with firm layers of coagula, which so tenaciously adhered to the inner membrane as to be separated with difficulty; when separated, the surface was found to be perfectly smooth and natural."[5] The second preparation shows the result of a ligature applied to the jugular vein of a horse for twenty-four hours. The inner vein-wall, thrown into longitudinal folds, is otherwise natural in appearance, whilst a good deal of lymph is accumulated externally around the ligature. The third, which with the preceding, is in the museum of St. George's Hospital,[6] shows the effects of a ligature, including part of the parietes of the jugular vein of a horse. Some fibrin is deposited in the track of the thread and in a small pouch below, but no evidence exists of any inflammation of the lining membrane, and this three days after application of the ligature.

In the museum of St. Thomas's Hospital[1] is a preparation of the jugular vein of a horse, with a circular aperture formed by ulceration of the wound made in phlebotomy. Its internal margin and the surrounding membrane is coated with adhesive matter. As in this case the interior of the vessel communicates with the tissues outside the vein, the adhesive material may have made its way into the vessel from diseased tissues which surround it. But, respecting this presence of adhesive material within veins, an error was originated and perpetuated by the experiments of Gendrin. "Should any imagine," writes Hasse, "this false membrane to be not the product of plastic effusion from the coats of the vein, but an immediate deposit from the blood, let him refer to the experiment of Gendrin. Having secured a portion of an artery between two ligatures, and entirely cleansed it of blood, that experimentalist discovered, after throwing in an irritant injection, a plastic membrane deposited within the part so insulated, filling up the whole calibre of the vessel; and he affirms that similar results followed in experiments upon veins." Notwithstanding the credit this view long obtained, and the support it received from authorities in this country, its accuracy was disproved by Lee. Having found that inflammation of the coats of the veins only occurred when the blood had previously coagulated in them, he was induced to believe that the deposit found in the veins might be derived directly from the blood. Gendrin's experiment was, therefore, repeated; and when precautions were taken to exclude all blood from the vessel, no lymph was effused in the vein.

In repeating this experiment, I find, however, that lymph is occasionally found within the veins, but that its presence is due to an effusion external to the vessel. The precaution of closing, by ligature or otherwise, the opening through which the irritants are introduced, effectually secures its absence. The following experiments show the result as this precaution is, or is not, taken. They show that the lymph, when present, finds its way into the vein from without, and is not exuded from or through the lining membrane. Neither, in animals, does the internal coat inflame when irritated.

1. Part of the femoral vein of a dog being selected, free from anastomosing branches, a

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[1] Sylloge Opusculorum selectorum; dissertatio Hallæ habita anno, 1797, p. 185. Also Frank, Epitome de Curand. Hominum Morb., lib. i., p. 187.

[2] Traité d'Anatomie pathologique générale, tome i., p. 290.

[3] Hunter, Works, vol. iii., p. 584.

[4] Series y, 151.

[5] Travers, Surgical Essays, plate xiii.

[6] Series vi., 173, 193.

[1] Series y, 152.

ligature was applied so as to stop the blood coming from the extremity. The vein w then opened by a longitudinal incision, and the blood in the vessel was removed. A second ligature was then applied between the longitudinal cut and the first ligature, and a third was tied between the wound and the heart. After twenty-four hours, lymph was found in the latter interspace, but not in the first. There was also an abundant deposit of lymph external to the vessel.

2. Part of the femoral vein of a dog having been included between two ligatures, was punctured, all blood removed from its interior, and two small pieces of lead introduced within the portion of the vessel isolated by the ligatures. Twenty-four hours after the operation the vein was surrounded by lymph, a considerable quantity of which had entered the vessel through the puncture distending its canal, as may be seen in the preparation.

3. The femoral vein of a dog having been exposed, an experiment was made which resembled the preceding; but the ligature nearer the heart was shifted after introduction of the foreign bodies, so as to cut off the portion of vein in which the pieces of lead were included from communication with the puncture in the wall of the vessel. The lining membrane of the portion of vein thus isolated presented a natural appearance twenty-four hours after the operation.

4. A small piece of lead was introduced within the femoral vein of a dog and there suspended by a thread, as seen in the preparation. The puncture in the vein-wall was then closed by a ligature, which had the effect of slightly narrowing the canal of the vessel. The blood was then allowed to flow through the vein for forty hours. At the end of this time the lining membrane of the vessel retained its natural appearance.[1]

From these considerations it is manifest that adhesive phlebitis has been very variously described and accounted for, and that its occurrence has been denied by some pathologists. There can be no doubt but that veins are repaired without its aid, and experiments upon animals, taken for what they are worth, show that the lining membrane of these vessels does not inflame when irritated. Absence of vessels from this membrane points, one would think, to a reason for its immunity. [It has been demonstrated that the lining membrane of a vein may, when irritated, increase in thickness by proliferation of its cellular elements, just as the intima of an artery does. It is by this process that veins plugged by coagula are permanently obliterated or even reduced to fibrous cords. The absence of bloodvessels in a tissue does not give immunity from irritative processes.] A tissue thus circumstanced may eventually be involved when adjacent parts are affected, but it rarely originates disease. As the barrier between tissues often inflamed on the one hand, and the blood-stream on the other, it would obviously discharge an important function did it prevent lymph from being effused on the internal surface of the vein. For although this lymph might be swept away without producing any local effect, it could not be mingled with the blood without risk of spoiling that fluid, or of causing secondary mischief by becoming entangled in, and so obstructing, the capillary vessels.

I prefer, therefore, to consider what has been termed adhesive phlebitis under the name of thromballosis.

Thromballosis.

The changes which result from *coagulation of blood* within the veins (thrombus, as Petit terms it[1]) may easily be mistaken for processes of an inflammatory character, unless the beginnings of the disease are accurately observed.

Causes.—As it has been elsewhere shown[2] that the blood-fibrin, under certain conditions, is apt to coagulate spontaneously within the vessels, it will here suffice to recall the fact. Coagula may indeed form, as a means of repair, be the blood condition what it may. They do so in arteries after application of a ligature. They do so in veins when wounded or when torn across, and are then sufficient to close the rent, and eventually to repair it. In these cases the coagula are limited in their extent. But in other cases, and to these our attention is now directed, when a clot is formed within a vein, it increases and extends from one to another, until having commenced perchance in a vessel of small size, it reaches and fills the largest.

This remarkable tendency of the fibrin to coagulate within the veins may exist, unsuspected, in the ill-nourished and feeble, or may be slowly induced during the progress of disease. Some trifling circumstance is then sufficient to call it into action. Bouillaud states[3] that those dying from phthisis or from cancer often suffer from the formation of clots in veins.

In one case the external iliac was thus filled with a coagulum where compressed by

[1] Museum, St. Bartholomew's, series xiii., 156.

[1] Also named *embolism*, from ἔμβολον, a plug. The term *thromballosis* more correctly indicates this disease (θρόμβος, a clot, and ἀλλοιόω, to change).

[2] Vol. i., p. 557.

[3] Traité clinique des Maladies du Cœur. Bidault (Recherches sur les Concrétions sanguines des Veines, Paris, 1850) states that Legroux first drew attention to the spontaneous formation of clots in veins.

intestine distended with feces. In another, a tumor pressed the vena .va; in a third, a cancer growth the internal iliac; and where the pressure fell, there each vessel was closed by coagulum.[1] In the body of a young man who had long lain in one of the wards of St. Bartholomew's Hospital with his thighs drawn up on the abdomen, the femoral veins were closed by clots above the junction of the profunda, and as high as Poupart's ligament. The mere flexing of the vessels had sufficed to determine the coagulation, as he slowly died with phthisis of the lungs.

The circumstance which called the coagulating predisposition into activity, seems, in these cases, to have been (1) the pressure upon the vessel. So again in the following case :—

On December 6, 1860, I examined the body of a male patient who had long suffered from dilatation of the pelvis of the right kidney, in consequence of impacted calculus. Pericarditis was the immediate cause of death. The vena cava inferior was compressed by the dilated pelvis (which formed a cyst holding four pints of fluid), and was somewhat narrowed above the junction of the common iliac veins. The right common iliac was filled by a coagulum in part soft and blood-stained, decolorized where in contact with fluid blood coming through the opposite vein. It extended far towards the leg, even to the veins about the middle of the thigh, and the right lower extremity was œdematous.

In these cases, the pressure is often slight, and generally acts upon one side of the vessel, the vein being free to yield in the opposite direction. They must be distinguished from those cases in which the pressure is made upon the whole circumference of a vein, or if acting on one side, compresses the vessel against a resisting substance such as bone. The vein is then filled with a coagulum distinct or mingled with an ingrowth from any tumor which may happen to surround it, and eventually, if the vessel become obliterated, clots form on the distal side of the obliteration, just as after application of a ligature.

[Clots form in the veins of weak or cachectic patients at points where pressure can hardly be invoked as a cause. Thus, such thrombi are commonly found in the sinuses of the cranium as well as in the femoral or axillary veins. The explanation suggested by Lancereaux is that at these points the arterial impulse prolonged through the capillaries is fully lost, and the suction exerted by the expansion of the thorax during inspiration is least felt. It has been noticed also that clots usually begin within the pouch of a valve or on the spur of a bifurcation of the vein.]

This occurred, for example, in the case of a woman, aged twenty-three years, who suffered from osteoid cancer, involving the lower part of the left femur and the popliteal space. The limb was amputated at St. Bartholomew's Hospital. The diseased portion was examined November 23, 1861. The popliteal veins, there were two, were obliterated, and could not be traced amidst the substance of the tumor; but above and below the obliterated portions the vessels were filled with firm colorless coagula.

Other circumstances, however, more often determine the formation of coagula. (2) Inflammatory changes in the tissues which surround veins. Thus at the base of an extending ulcer the veins are filled with coagula.[1] As the disease advances, the clotting goes before, and plugs portion after portion of the adjacent veins. Rendered solid, they may indeed soften and slough as the disease progresses, but hemorrhage is, as a rule, prevented by their previous obliteration. (3) Laceration of a vein, as when the placenta is expelled from the uterus. Some blood escapes and coagulates without, and some, but not much, within the vessel, which is itself contracted. Thus, and by subsequent changes, the vein is permanently closed. The extension of clots, which results in either of these circumstances, though of common occurrence, has received scanty attention.

In illustration, I will narrate two or three cases.

In the body of a man brought to St. Bartholomew's for dissection, death having resulted from phthisis, the nates were covered with sloughing sores. The left femoral, just below Poupart's ligament, was filled with a firm coagulum which ascended to the junction of the epigastric vein. Attention was drawn to numerous veins about the base of the sloughs, which were more than usually conspicuous from being distended with clots. They converged towards and formed the left internal circumflex, and so extended direct to the femoral; and, without doubt, accounted for the clot which had formed there in direct continuity with those in the smaller vessels.

In February, 1864, a woman, aged twenty, died, after amputation of the thigh, with symptoms of pyæmia; there was no evidence of vein obstruction about the vessels of the thigh; but, on making a careful examination of the pelvis, to which I was led by the fact that a large bedsore had formed over the sacrum, a thin plate of fibrin was found at the junction of veins to form the right com-

[1] See cases by Forbes and Holberton, in Med.-Chir. Trans., vol. xiii., p. 293, vol. xvi., p. 62; also Museum, Guy's, 1523[60].

[1] Museum, St. Bartholomew's, series xiii., 61; Middlesex, vi., 52; St. George's, series vi., Nos. 176, 177, 178.

mon iliac. This fibrin partly hindered the flow of blood from the external iliac, but being broken away from the mouth of the internal iliac, had allowed a quantity of soft clot debris to pass into the circulation; this came from the ischiatic vein, which was filled throughout its entire length by old and softened coagula. The lungs were filled with secondary deposits. In this instance the thromballosis had extended in the veins about the sore on the sacrum, not from that about the amputation wound of the thigh.

My friend, the late Dr. Baly, sent me the following report of the case of a female aged sixteen years, a prisoner in Millbank. On January 20, 1844, she was placed on the sick list. She was of a strumous aspect, and had suffered from attacks of diarrhœa and of dysentery, attended with pain about the head, and cramps. The day following the cramps ceased. Pain and tenderness about the epigastric region persisted. The third day she began to complain of pain in the right side of the head, and the right side of the face was slightly swollen. The gums were somewhat affected by mercury she had taken. A glazed red streak extended from a pustule on the right side of the nose to the inner angle of the eye, terminating abruptly. A good deal of the pus had discharged from the pustule during this and the preceding day. The fourth morning she was seized with convulsions of an epileptic character. She became insensible, and on the fifth day she died. The body was examined twelve hours after death. The right cavernous sinus was filled with clots and puriform material, as also was the ophthalmic vein. Elsewhere each sinus contained dark fluid blood. Two veins, one from the dura mater, the other from the brain, were filled with clots. The vein by the side of the nose also contained coagula. Part of the brain lying over the cavernous sinus was ecchymosed, the blood was coagulated in its vessels, and its tissue softened. From the pustule to the softened brain tissue the progress of the disease was distinct, and not to be mistaken.

Examples to show how veins, after wounds and rupture of their walls, become obstructed with clots, may be taken from those cases of œdema of the legs, so often following parturition, bad fractures, and even severe contusions.

On July 19, 1855, a woman, aged twenty-four years, was admitted into St. Bartholomew's Hospital, who had enjoyed good health until, about six months before, she had fallen from a height, and severely bruised herself about the pelvis. Two months after she was confined at the full time. A few weeks before she had noticed some swelling of her legs, and she subsequently suffered from obscure abdominal pains, with occasional hemorrhage from the vagina. Her emaciation became extreme. The lower extremities became permanently œdematous, and hard cords could be traced along the course of the principal veins. Exhausting diarrhœa baffled treatment, and, sinking gradually, she died about eight months after her confinement. The femoral and all the iliac veins being removed after death, presented the following appearances: In places they were greatly distended, firm, and resisting. Between such portions they were contracted and empty. All smaller veins opening into these trunks were occupied by firm, decolorized clots. The tissues around were natural, save about the femoral veins, where they were somewhat thickened. The coagula clung pretty firmly to the walls of the vessels; they showed an arrangement of concentric layers, easily separated one from another. At the contracted points, the walls, as elsewhere, presented a natural appearance. All other parts of the body, excepting the œdematous legs, presented a natural appearance.

Again: a woman, aged sixty-two years, died in the same hospital, forty days after a comminuted fracture from direct violence about the upper and middle part of her right femur. Her death resulted from exhaustion; she sank gradually, with extensive bedsores. The right lower extremity was slightly œdematous. Great ecchymoses were found about the adductors and the vastus internus. The profunda and its formative branches were plugged as high as the junction with the femoral vein with softening blood-stained clots, of the existence of which there was no suspicion during life. The fractured femur remained ununited. The important relation between these clots and the occurrence of non-union will be subsequently noticed. The predisposition which inclines the blood to form these continuous clots is thus called into activity by accidents of common occurrence.

The coagula extend in all cases in one of two directions—(*a*) against, (*b*) with, the blood-stream. To assist in explaining their extension, the formation of a coagulum in an artery on which a ligature has been tied, must be referred to. It is thus noticed by Jones:—

From these circumstances it appears that the enlargement of the portion of the artery between the first collateral branch and its extremity is prevented; but it is obvious that there must be a small quantity of blood just within the extremity of the artery, and which is more or less *completely at rest;* it *therefore coagulates,* but does not appear in every instance to form a coagulum capable of filling up the canal of the artery; for, as may be observed in many of the experiments, several hours after the artery had been tied, there was only a slender coagulum formed in its extremity. I am therefore disposed to think that though the artery cannot accommodate itself to the blood determined to it, yet it undergoes such a degree of contraction, as occasions too much motion in the blood which it contains to admit at once of its complete coagulation. It is a fact that in most cases only a slender coagulum is formed at first, which gradually becomes larger by

successive coagulations of the blood; and for the same reason it is that the coagulum is always at first of a tapering form, with its base at the extremity of the artery.[1]

The researches of Stelling[2] add little, if any, information. He observes, that the arrested blood forms a conical mass, whose apex is near the first lateral branch, and whose base is seated on the extremity of the vessel, and is contained within a funnel of blood in partial motion.

Now respecting this coagulum (thrombus) two facts deserve to be noted. The first is its formation independent of the division of the middle and internal arterial coats. If a broad ligature is tied round an artery so as to close its canal without lacerating the coats, a clot is readily formed between the ligature and the first branch on the cardiac side.[3] The second fact is that the blood is not stagnant above the ligature, that is to say, in a state of rest, as is usually assumed. On the contrary, it is agitated in an orderly manner, so that the fibrine is as it were churned out of the blood to form the

Fig. 301.

Diagram of experiment.

coagulum. This may be illustrated by the following experiment. Let an opening (*a*) be made in the side of a common glass test-tube. Between this opening and the closed extremity of the glass let the latter be filled with sand. A stream of water directed through an elastic tube adapted to the orifice (*b*) of the glass will quickly remove the greater part of the sand through the lateral outlet (*a*). What remains will assume a spiral shape, whilst the particles of sand as they are whisked away will indicate a spiral movement of the water stream, as shown by the plain and dotted lines in the annexed diagram. As the relations are varied between the velocity of the stream, the diameter of the outlet, the diameter of the tube, and the distance between the closed extremity and the lateral opening, so of course will the result be modified.

It is in the midst of such an orderly movement, that fibrin is probably separated from the blood above the ligature and forms the spiral and conical clot, which extends to the first lateral branch (where the churning movement ceases), and which, consisting of separated fibrin, is from the first colorless.[1]

[The formation of a clot within the closed extremity of an artery beyond the nearest collateral, seems to be as much the result of stagnation as of churning. The strong currents are on the side, and the clot forms in the centre, where the motion is least. Moreover, the current is stronger at the level of the collateral branch than it is in the closed extremity, and therefore the growth of the clot instead of ceasing at that point should be more rapid if it depended solely upon the whipping out of the fibrin, and the process, once begun, would continue until the entire venous system was plugged. In short, the conditions which govern the formation and growth of a clot are not fully understood.]

Under like circumstances, clots form and extend in an obstructed vein (Fig. 302, *a*) in opposition to the stream as far as the first branch, as at *b*, where the blood turns back through the collateral vessel (*c*); they also form where the blood regurgitates, as in the subclavian from disease of the heart;[2] but these coagula are produced less rapidly than in arteries, and their fibrin is often largely mingled with other blood constituents. The blood also finds its way into the vein on the cardiac side of an obstruction (*d*), and supposing vessels (*e e*) to be torn across, what with an external clot (*f f*) and the coagulation within, as at *d*, they are soon

[1] On Hemorrhage, p. 159. See also Halleri Op. Min., t. i., exp. 54. "Sensim vero de arteriâ ligatâ sanguis collectus ita refugit ut nullus supra vinculum sanguis maneret, sub lino vero copiosior et stagnans superesset."

[2] Die Bildung und Metamorphose des Blutpfropfes oder Thrombus in verletzten Blutgefässen; Eisenach, 1834.

[3] Museum, St. Bartholomew's, series xiii., 141.

[1] Reference is made to these observations in the article Venenwunden, by O. Weber, in the Handbuch der allgemeinen und speciellen Chirurgie, p. 99 et seq.

[2] Guy's Hospital Museum, 1521[30].

plugged to their junction with a larger vessel. The end of the clot in contact with the blood-stream, if in a small vein which opens into one of large size, is round or flattened; if, on the other hand, it occupies the large vessel, its extremity,

Fig. 302.

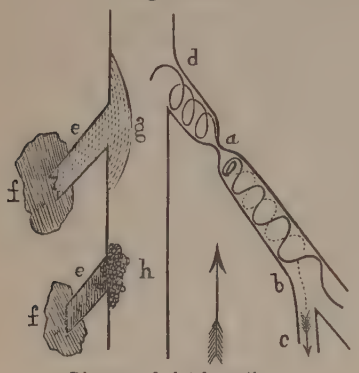

Diagram of clot-formation.

moulded by the lateral current, is tapering, or otherwise modified in its shape.[1] Beyond any such point the extension of the clot depends, as shown by Virchow, upon deposits from the blood as the latter flows over the coagula, and these additions of fibrin may be arranged in orderly layers (*g*), or may be deposited irregularly, leaving a rough surface, as at *h*.[2] By these accumulations the largest veins may be so nearly occluded that a slight additional coagulation at any moment completes their closure. Vessels thus plugged present the appearance shown in Fig. 303 (from an obstructed profunda vein), the yellowish or white clot, having as is usual a spiral shape, and colored coagula filling its interspaces (often speckled with fragments derived from the fibrin masses), the whole bearing below an impression of the vein-valves.

The changes hitherto described, although as often independent, are frequently associated with ordinary inflammation of parts around the veins, as may be seen in the greater number of the preparations in the London museums. As a

Fig. 303.

View obstructed by clot.

consequence of such inflammation (the so-called adhesive phlebitis), small vessels quickly fill with clots; and if a main trunk is then examined, its inner surface will be found dotted over with what at first sight look like plates of lymph, but which are in reality the clots projecting from the branch veins, some firmly attached, some hanging loosely in the canal. From these, as starting points, the main vein becomes in turn obstructed with coagula, more especially if its outer walls are implicated in the inflammation, the clots having often a regular laminated arrangement. At the first large vessel which joins the affected vein the clotting is arrested by the incoming blood-stream; but, if, as has been already shown, the disposition to clot-formation is strong, it is only checked at the junction of collateral vessels, and may extend with scarcely any limit either towards or away from the centre of the circulation.

When these clots are removed, the lining membrane of the vein beneath presents a natural appearance; but its outer and middle coats are not unfrequently thickened, and if there be much contraction of the tissues around subsequent to their inflammation, the vein may be

[1] See woodcut, vol. i., p. 557; also Museum, Guy's, 1521[22]; Middlesex, vi., 52.

[2] It is from these projecting coagula that fragments and even large masses are separated, pass into the blood-stream, and are carried by it to be eventually lodged in distant organs. Several cases are recorded in which sudden death has been caused by the lodgment of such a fibrin mass in the pulmonary arteries; the consequences of their arrest in the arteries of the brain, whither they are usually carried from deposits on diseased valves of the heart, have been fully investigated by Kirkes; and the whole subject of occlusion of the arteries from this cause will be found treated of in the following essay. Plate viii. attached to Davis's paper in Med.-Chir. Trans., vol. xii., and preparation 1521[22] in Guy's Hospital Museum, are excellent illustrations of coagula in a position to be thus washed off by the blood-stream. See also recent observations by Bastian and others, and by Tuckwell in St. Bartholomew's Hospital Reports, vol. v.

thrown into longitudinal folds, or may become tortuous.[1]

As each coagulum is formed, it contracts; and it often happens, being firmly fixed by its roots, as we may term its prolongations into the small branches, that the vein-wall is drawn with it in its retraction, becoming condensed and thickened in appearance, so much so that when cut across it resembles an artery. Indeed this condition is generally mistaken for an inflammatory thickening of the vessel; but in the case of the young woman narrated at page 287, suspecting the nature of the change, I removed the internal saphena, which was contracted, thick, and hard like a piece of whipcord, and having injected water into a part of the vessel, easily restored that portion of the canal to its ordinary size, and the vein-wall to its usual appearance, so that in the preparation[2] it forms a marked contrast to that part of the vessel which remains condensed. Had its walls been thickened by any inflammatory deposit, they would not have yielded to the slight pressure which was employed. I have recently had many opportunities of repeating this experiment.

Sometimes the coagulum shrinks to one side, being more tightly held by the branches in that than in the opposite direction, and under favorable circumstances the blood, incessantly endeavoring to insinuate itself into the obliterated vessels, may form a channel by the side of the clot, between it and the vein-wall, or in rare instances (referred to by Ribes and others) may drill for itself a passage through the centre of the clot. Under such circumstances the circulation is re-established, though still hindered by portions of fibrin, which form bands and cords stretching across the canal.[3]

It more commonly happens that the obliteration is permanent, and the vessel is lost to the circulation, the clot (frequently organized) and the vein ultimately forming a firm, shrunken, sometimes calcareous cord. The collateral circulation carries off the blood which should have passed through the lost vessel; though, before this is established, and even after, there is œdema from those parts from whence the return of blood is hindered, and occasionally even hemorrhage. The extent and severity of this œdema (*white swelling*) will depend (*a*) upon the size of the vein obliterated, (*b*) upon the extent of the obliteration, and (*c*) upon the sufficiency of the anastomosing vessels to remedy the obstruction. When the œdema is attended with considerable pain, a low state of inflammation is superadded. The part is swollen and hard, but does not pit on pressure, as in anasarca, and is not red, as in phlegmonous erysipelas. But these affections are nearly allied, as the one causes cellular inflammation, and erysipelas itself almost always occasions an affection of the veins.

This œdema often embarrasses the repair of fractures, more especially when the breakage is near a medullary foramen and involves the laceration of a large vein, or when the tissues around are greatly bruised from the direct violence of the injury, so that clots form in the principal vessels. As this complication is of such common occurrence and of such serious importance, it is strange that attention has been so little directed to it in cases of tardy or non-union. It may be suspected when, about the fourth week after the injury, the parts continue or become œdematous, cold, and often aching. The remedy consists in endeavoring to improve the circulation through the superficial veins, which are least often obstructed, by friction with the hand and by position. It is, however, always a serious affection, as shown by the frequency with which opportunities offer for inspecting the bodies of old and feeble people who die some weeks after a fracture with no trace of union, but with numerous ecchymoses and plugged veins around the seat of injury.[1]

It depends upon the quality of the fibrin whether it causes these simple obstructions, or whether it softens and disintegrates, forming a thick yellow fluid, sometimes blood-stained, which resembles pus (puriform) in its appearance, and which, with the complications it may give rise to (pyæmia), has been already described.[2] The clot when softened is usually shut off (sequestered) in an upward and downward direction by newly-added coagula. And here I may observe, that the softening begins, as a rule, in the coagula last formed, not, as Virchow states, in those first deposited. For in the advance of the malady the patient's health fails, and the fibrin becomes more and more prone to disintegrate and soften into a puriform fluid.

The symptoms of obstruction of the deep veins are obscure, even when attended with ordinary inflammation of the parts

[1] Museum, College of Surgeons, 1725.

[2] Museum, St. Bartholomew's, xiii., 157.

[3] Museum, St. Thomas's, v, 162, 168. With reference to the occasional dilatation of these clots and their connection with the formation of aneurism, see a case I have reported in the Path. Trans., vol. ix., p. 93; and Remarks by Dr. Ogle on the Formation of Aneurism in connection with Thrombosis, London, 1866.

[1] See "Notes on Non-uniting Fractures," Med.-Chir. Trans., vol. li.

[2] See PYÆMIA, vol. i.

around. There may be some constitutional disturbance; the superficial veins may be congested, and after a time the occurrence of œdema may be noted. When the limbs are affected, they feel hot and dry, are usually flexed, and cannot be extended without considerable pain. If the superficial veins are involved, they can be felt as hard cords under the finger, the induration being due to the thickening of the tissues around, to the clots within, or, more often, to the two conjointly. The course of the attendant inflammation is marked by redness and tenderness, and may be distinguished from inflammation about the lymphatics by the small size of the cords in the latter, its superficial character, and the rose-colored redness of the skin. The diagnosis between affections of the deep veins and of the absorbents is not so clear. An accompanying injury, from which the mischief may have started, and which is generally a contusion or an open wound of some kind, will usually suggest to us the probable condition of the neighboring veins.

In many cases no danger is to be feared; but when large and important veins are extensively affected, as those of the pelvis and lower extremities conjointly, nutrition is so largely hindered that death by no means unfrequently results. The obstructions often cause serious complications, as has been already mentioned, and there is danger of portions being separated from the clots in the veins and causing secondary mischief in the capillaries of various organs (pyæmia).

Treatment.—If the nature of this affection is rightly understood, the description of its treatment becomes simple enough. The patient's health must be upheld by doses of bark, or of any other approved tonic; and a generous diet must minister to his amendment. If there be any error, it will be on the side of not doing enough in this respect. Locally, rest must be insisted upon, if possible in such a position as shall favor the circulation through the part affected. The circulation should be promoted in the superficial veins, as has been already indicated, as the surest means of relieving œdema. If there be pain from an inflammation, it may be soothed by warm fomentations; if it be chronic and from œdema, it is useful to give opium in some form, and thus for the time relieve it. Each case in which the symptoms are at all serious will probably require patient watching; for the disease, with its series of stages, the coagulation, the eventual obliteration, and the righting of the circulation, is of slow progress, and must, after all, be left pretty much to nature. Our anxiety to render assistance should never lead us to the employment of such remedies as blisters applied to the œdematous limb; nor can aught but harm be anticipated from depletion, the use of mercury, or of such-like powerful medicine. Except in the case of the complications to which I have referred, a favorable issue may be anticipated.

Suppurative Phlebitis.

It remains to refer to the so-called *suppurative* (diffuse) *phlebitis*. This disease is, in fact, nothing more than a diffused phlegmonous inflammation, and ought to be reclassed with disorders of that character, from which it was separated on account of a prevalent opinion that the inner membrane of veins was the part first and chiefly affected. This inflammation follows the course of veins which, acting as conductors, favor its rapid extension in the direction of least resistance; and hence, as a rule, the disease passes from the small to the larger vessels, since the cellular surroundings of the latter offer the easier route for its advance. That the parts around are first affected, and not the lining of the veins, is shown by the examination of fatal cases. There is no preparation of so-called suppurative phlebitis I am acquainted with in which the parts around the veins are not inflamed and thickened.

No patients in a fair condition of health could suffer from this disease. The worst they could be troubled with would be a limited (adhesive) inflammation of the parts around the vessels, with attendant obstruction of the veins with clots. But if the system is depressed and enfeebled, as when suffering from extensive ulcers, from large lacerations, or after severe operations, this disease, attacking wounds and adjacent structures, extends along the course of the vessels, just as in other cases it happens to extend along the subcutaneous cellular tissue, and is known as phlegmonous erysipelas. It arises from various local irritations; in one case, the puncture (venesection), in another, the division of a vein, is its starting point; and it often occurs after amputations, as after other wounds; not, however, in consequence of ligatures applied to veins. Whether these vessels be tied or not, this inflammation may supervene; indeed, in every amputation, as remarked by Blandin,[1] the veins which accompany small arteries are always tied; and we have no right to argue that the ligature of a large vein is more likely to be followed by diffused inflammation of its wall, than is that of the smaller vessels. Such an assumption cannot be justified.

[1] Journal hebdomadaire, tome ii., p. 579. Paris, 1829.

Whilst remembering that various degrees of severity exist between the limited (adhesive) inflammation of the tissues around a vein, and the most severe form of diffuse suppuration of the same structures, we will take a bad case of the latter as giving a correct idea of the nature and progress of the disease.

On March 27, 1861, I examined the body of a man who died in St. Bartholomew's Hospital under the following circumstances: He fell from a height, and so upon some iron spikes, which penetrated one into either thigh. Diffused inflammation became established along the track of the wounds, more especially on the right side. On the fourth day, without material aggravation of the symptoms, the right saphenous vein became indurated along its entire length. The lungs became congested, symptoms of dyspnœa were added, and he died (typhoid) on the seventh day. The right wound extended across the thigh to its inner side, and unhealthy pus was diffused far and wide, superficial to the fascia lata. The tissues around the saphena vein were laden with extravasated blood, and with unhealthy sanious pus. The glands, especially about the upper part of the thigh, were enlarged and blood-stained. The outer coat of the saphena was œdematous, the internal surface of the vessel was rough, and the inner coat was, for the most part, wanting. There was no increased vascularity of the vessel. Its canal was filled with sanious pus, and occasional shreds of blood-clots. Just above the inner ankle it was suddenly contracted, and contained a tapering coagulum; and here was the limit of the surrounding inflammation. The femoral vein, at its junction with the saphena, was laden with soft colored clots, which extended into the external iliac. The lungs were congested and œdematous.

The changes in this and allied cases may be described as an infiltration of the tissues around each vein with serum and corpuscular lymph. This quickly degenerates, and forms a series of abscesses, or rather a diffused collection of pus. The rapidity with which these results follow each other is most alarming. The veins at first contract, entangling as they do so, some few coagula; but presently such portions dilate. Beyond these, other parts of the same vessel are undergoing, as the surrounding disease advances, the earlier process of contraction; and again, beyond such portions, clots close their canal and mark the momentary limit of the disease. And so it extends, following the vein-course. All branch vessels are closed with clots, or involved otherwise in the disease, so that no blood flows through the vessel, and thus, and from the condition of the parts around, no nourishment can now reach the inner vein-coat; so it dies, becoming cloudy, forming an inorganic friable pulp, which gradually melts down until no trace of it remains. The inner coat being destroyed, pus finds its way into the dilated vessels, either direct from the other vein-coats, or through them from the parts around; for these coats, deprived like the inner of their blood-supply, frequently perish in the course of the disease.

The symptoms which accompany these changes are of a low, even typhoid character, ushered in with rigors, and a general increase in the severity of pre-existing signs. If superficial veins are involved, the accompanying induration and congestion of the parts around will mark the progress of the disease; if the deep vessels are implicated, it is upon the accession of general symptoms, and upon the uneasiness about the parts affected, that we must rely for a diagnosis, which indeed is not always easily arrived at. When diffuse suppuration is established, a satisfactory issue is doubtful, although in the less severe cases we may succeed in limiting, and so in arresting the disorder.

To effect this, every effort must be directed to the support of the patient with stimulants, nourishing food and tonics; warm fomentations applied to the parts affected, must be combined, if possible, with free incisions to allow of the escape of the unhealthy material depositing along the course of the vessels. But enough has been said in treating of erysipelas and of pyæmia, to render it unnecessary to enter here into details of management, which would be merely a repetition of those recommended for the aforesaid diseases.

In cases of diffuse suppuration, the coagula play an unimportant part, very different from that which they occupy in cases of clot-obstruction (more especially when they soften and acquire the puriform condition). Enough has been said to show the great difference between the two affections; but unlike as are the two diseases, they have this in common, that either may be the cause of those secondary complications to which the term pyæmia is properly restricted.

Infants occasionally suffer from inflammation about the umbilical vein, as noticed by Osiander, Meckel, and by Duplay.[1] It commences from the second to the twelfth day, and is often produced by some injury which the child has sustained. In other cases, it would seem to depend upon influences the same as those causing puerperal fever and allied disorders. Duplay found in three out of six cases that erysipelas was associated with the affection of the cord; and occasionally

[1] Revue médicale, 1838, tome iii., p. 104. See also Morgagni, Epist. Anat. Med., liii., art. 37.

even local gangrene occurs, thus showing the low phlegmonous character of the affection. The general bad condition of the children is also indicated by discharges from the mucous membranes, and by the co-occurrence of purulent ophthalmia. Death occurs from the thirteenth to the sixteenth day. The entire cord is involved, thickened, with the structures around, and often with peritonitis. The umbilical vessels are all obliterated in the common affection, their canals being filled with clots, which have been found to extend into the portal veins. The diet of the child and the various secretions require attending to, and warm fomentations may be applied to the inflamed structures; but the tender age of the infant is unequal to resist so serious a disease, for a fatal result has followed in all recorded cases.

Some veins not infrequently contain loose *calculi* or phleboliths, generally round or oval, and sometimes attached by a narrow pedicle to the inner wall. No inconvenience results from their presence. They are found most frequently in the veins of the pelvis about the bladder and prostate, especially when the latter is enlarged.

Their origin has been much questioned. Bichat[1] thought that they occurred in veins exposed to slow circulation of their contents. Hasse found them connected with varices. Hodgson[2] held that they were probably formed in surrounding parts, and made their way into the veins by absorption. Cruveilhier stated that they were developed in the centre of a clot of blood. It is, however, most probable that they are clots which have thus dried up and become transformed. Having protruded from some small branch, they receive additions to their surface, and, eventually separating from the pedicle which held them to their original vessel, shift their situation, and are perhaps rolled along for some distance by the blood-stream before being finally arrested.

They are formed of concentric layers, which consist, according to an analysis kindly made for me by my friend and colleague Dr. Frankland, of protein matters and phosphate of lime. The former, constituting about twenty per cent. of the calculi, are nearly all albuminous or fibrinous; the latter, though mainly phosphate of lime, is mingled with a little sulphate of potash and sulphate of lime. That is to say, the phleboliths consist, as might be expected, of the coagulated protein constituents and the less soluble salts of the blood.

[1] Anat. gén., par Béclard, p. 104.
[2] Dis. of Arteries, p. 511.

Hypertrophy and Atrophy.

Hypertrophy of veins occurs when any part of the body is the seat of increased growth. It is a natural and healthy change. Thus during pregnancy the uterus is provided with enlarged channels for the removal of its venous blood; and thus in a case of medullary cancer of the omentum I have seen the portal vein twice its natural size, in consequence of the large quantity of blood carried to it from the rapidly-growing tumor.

With this form of hypertrophy there is proportionate dilatation, so that the vessels are perfect to perform all their functions. They are thus adapted to new conditions, as when an artery is wounded through a vein, and the latter dilates (aneurismal varix) above and below, its walls becoming thickened so as to resist the arterial impulse.

Hypertrophy with dilatation also compensates for many obstructions to the circulation by fitting one set of veins to make up for the loss of any other. Thus no inconvenience follows when superficial veins are obliterated, for by dilatation of anastomosing branches the circulation is readily re-established. When the vena cava inferior even is permanently closed, it is well known that the lower portion of the vessel dilates in common with the branches opening into it; that various small veins become large—for example,

[Fig. 304.

Collateral venous circulation; taken from a woman æt. 47 (under the care of Sir W. W. Gull), in whom the inferior vena cava was completely obstructed from cancer. Guy's Hosp. Mus., drawing 44[40].]

the superficial abdominal or azygos major[1] —and so carry to the heart the blood which ought to have reached the right auricle by the usual channel. Such cases have long been on record. One, described by Halford, is preserved at the College of Surgeons, and shows the iliac vein slightly dilated below an obstructing coagulum, a varicose (dilated) set of veins about the groins having carried on the circulation for several years before death.[2] This kind of dilatation ceases when the veins can conveniently carry the extra quantity of blood, and the change is permanent or temporary as the obstruction remains or is removed, for in the latter case the veins usually regain their ordinary size.

The only anatomical change which attends this increase of a vein is the addition of transverse fibres to its middle coat; its length is unaltered, and its walls remain smooth and uniform, save where pouches behind the valves account for slight irregularities; but as noticed by Baillie and Watson,[3] "the vessels are often bent and twisted when the current forces its way backward against the opposing but ineffectual barrier of the valves."

If the obstruction to the circulation is in the heart, or in the lungs, that is to say, in one of the central organs through which all blood must pass, no round-about channels can rearrange the circulation. The veins still dilate, but the change is passive, and accommodates them to the blood which accumulates within their canals, because its onward passage is impeded. Thus it happens, with obstruction from disease of one of the valves of the heart, that the entire venous system dilates, so that veins which can be seen, such as the external jugular, are turgid and distended. Maybe, with this dilatation, there is proportionate strengthening of the vein-wall; but it more commonly happens that the yielding is simply passive, increasing until relieved by rupture of the wall (hemorrhage), or by exudation of serum (anasarca).

Atrophy of veins, in common with atrophy of other structures, naturally follows disuse of a part. After amputation above the knee, the femoral vein lessens to one-third of its previous size; after removal of a testicle, the corresponding spermatic veins shrink and waste. In a case in which the right kidney had been transformed into a large cyst from the impaction of a calculus in its ureter, the canal of the renal vein would not admit an ordinary sized probe.

Degeneration of the coats of a vein never associates with atrophy of the vessel; indeed, its rarity under any circumstances offers a marked contrast to its frequent occurrence in arteries. In the museum of St. George's Hospital,[1] a vein from the broad ligament of the uterus contains a round white mass within its tunics, the vein being pervious; in another case,[2] a calcareous deposit involves the internal saphena; and Baillie mentions a case where a similar deposit was found in the coats of the vena cava inferior, near its division into the common iliacs. Béclard observed calcareous degeneration in the femoral vein, and Macartney and Andral in the internal saphena. It has also been met with in the hepatic veins;[3] but its occurrence may be considered accidental wherever situated. Indeed it is doubtful if these calcareous plates should be regarded as a degeneration of the vein-wall; it is more probable that they depend upon an after change in some local deposit of fibrine.

Varicose Veins.

Varicose veins. Varix.[4] *Phlebectasis.*—When a vein becomes dilated without any good object or purpose, it is said to be varicose. In the active or passive dilatations already described, which adapt these vessels to certain states of the circulation, the purpose is as evident as is the gain which results. Not so with varices. No good comes from them. They are useless and hurtful.

Many of the early medical writers were familiar with much that is at present known respecting varix. It is still the "dilatation of a vein" described by Paulus Ægineta;[5] and our treatment of the dilated vessel continues practically unchanged. Some veins, so far as is known, are unaffected by varices, while among those which have been reckoned as varicose a considerable number ought rather to be referred to that hypertrophy with dilatation which has been already described. Thus the tumors formed of tortuous and dilated subcutaneous veins (fancifully

[1] Museum, Guy's Hospital, 1521[32].

[2] Museum, 1732. See cases by Morgagni, Portal, Petit, Cline, and others; also Reynaud, in the Journal hebdomadaire, tome ii. Paris, 1829.

[3] Museum, Middlesex Hospital, series vi., 32[c]. Trans. of a Society for the Improvement of Med. and Chir. Knowledge, vol. i., p. 127.

[1] Series vi., 191.

[2] Museum, St. Thomas's Hospital, v, 170.

[3] Museum, College of Surgeons, 1438.

[4] *Varius*, unequal. Græcis στρεβὸς aut ἰξία Hippocratis dicitur.

[5] "Varix venæ dilatatio est, aliquando in temporibus, aliquando in una ventris parte, sub umbilico, nonnunquam etiam circa testiculos, sed maxime in cruribus."—Opus de Re Medicâ, Lat. don., p. 50. Paris, 1532.

likened by Severinus[1] to the head of Medusa), which occasionally occupy the hypogastric region, simply compensate for the obstruction of some large vessel, such as the vena cava inferior, unless indeed they are due to that congenital communication in rare cases maintained between the portal system and subcutaneous vessels of the abdomen by means of a patent umbilical vein, and of which a few instances are on record.[2]

[It is claimed by recent writers that the enlarged veins sometimes found centring at the umbilicus communicate not with the umbilical vein, as alleged, but with the veins of the suspensory ligaments of the liver. Bearing in mind the absolute isolation of the vessels of the umbilical cord from those of the abdominal parietes, it is not easy to comprehend how this alleged communication between them could exist.[3]]

True *varices* are commonly met with in the submucous veins of the bladder and rectum (hemorrhoids),[4] in the spermatic veins (varicocele, cirsocele),[5] and in the veins of the lower extremities. They are also, though rarely, met with in the veins about the face, more especially those of the lips and eyelids. In one specimen they may be seen involving the internal jugular;[6] in another the veins of the stomach;[7] and they are said to affect the pharynx, œsophagus, and small intestine, but of these the records are unsatisfactory. One case of varix at the bend of the elbow is recorded by Petit; and a boy is stated by Warren to have suffered from varix which formed between the shoulder and elbow after violent muscular exertion;[8] but phlebectasis of the upper extremities is a very rare occurrence.[9]

Varices of the *lower extremities*, though much had been written respecting them, received but little attention from anatomists. This neglect occasioned and maintained the error of Boyer, adopted by most of those who wrote upon the subject, that varices are an unnatural permanent dilatation of the *subcutaneous* veins, from which the *deep* veins are at first exempt, and that the latter, constantly sustained by the muscles, receive from these contractile organs a support by which they escape dilatation, whilst the subcutaneous, less well supported, can expand indefinitely.[1] The disease, limited in its origin to one set of vessels, was said to be caused by a retrograde movement of the blood, or by a mechanical obstacle to the return of the blood to the heart, or by a communication between the arteries and veins, small vessels passing directly from the one to the other. The last suggestion, however attractive in theory, failed from the absence of anatomical proof, for the presence of the anastomosing vessels has never been shown by dissection.[2]

The error of Boyer's doctrine rested upon insufficient anatomical research; for in fact varices do not invariably commence in the trunk of the saphena, or in that of any superficial vein. The seat of varices, as shown by Verneuil,[3] is as often in the deep veins, and they thence extend to the subcutaneous vessels by the numerous anastomoses existing between the two sets; and far from being rare, the deep varices are of very frequent occurrence.

There are various veins in the thickness of a limb; some deeply seated in company with the great arteries, the popliteal, posterior tibial, and the like; some which lie in the subcutaneous tissue; and lastly, intramuscular veins, which convey blood from the muscles to the deep or superficial vessels, and form anastomoses between them. These intramuscular veins carry large quantities of blood, and their capacity is great in proportion. I find that the six principal veins which pass in the adult male from the soleus muscle to the peroneal and posterior tibial vessels, have a united diameter of not less than an inch. Where these vessels open into the deep veins (more especially the peroneal and posterior tibial) the latter are often greatly dilated, as may be seen by the accompanying diagram, which indicates their condition in a case of varix which I examined in a body brought to St. Bartholomew's for dissection. Broca, quoted by Verneuil, found deep varices equally with the subcutaneous; Denucé observed that they were less rare than

[1] M. A. Severinus, De recond. Abs. Naturâ, cap. ix., § 13.

[2] Cruveilhier, Anat. path., liv. xvi., pl. 6.

[3] See Langenbeck's Archives, vol. xxiv., p. 521, for cases.]

[4] See Diseases of the Rectum.

[5] See Diseases of the Male Organs of Generation.

[6] Museum, St. Thomas's Hospital, y, 155.

[7] Museum, College of Surgeons, 1158.

[8] Traité des Maladies chir., tome ii., p. 49; Surgical Observ. on Tumors, p. 432.

[9] An interesting preparation in the Museum of St. George's Hospital, series vi., 242, shows all the deep veins of the arm varicose. The clusters of veins surrounding the main artery received an obscure pulsation from it, and there was much difficulty in determining the nature of the affection. It was noticed to come on after striking a violent blow.

[1] Boyer, Traité des Maladies chir., tome ii., p. 451; Sir Everard Home, Practical Observations.

[2] Pigeaux, Traité pratique des Maladies des Vaisseaux. Paris, 1843.

[3] Gazette médicale, 1855. Gazette hebdomadaire, 1861, p. 428.

had been supposed, and existed even when the subcutaneous veins were unaffected; Deville and Fouché, their attention being called to the subject, confirm his statements; and Dumay communicates a case in which, whilst tying the peroneal artery, it was found to be surrounded by large varicose veins with extremely thin walls.

According to Verneuil, the intra-muscular veins also become varicose, and specimens are preserved in the Musée Dupuytren[1] to show they are sometimes affected without change in the subcutaneous. In my dissections I have failed to meet with this intra-muscular varix;[2] but from the examination of bodies brought for dissection, in which varices are occasionally

Fig. 305.

Diagram of dilated veins (see p. 296).

discovered, and in which the vessels have been carefully traced, I can confirm the statement of Briquet, that at the spot where varices are most common, large trunks communicate through the muscles with the deep veins; and I find the latter as commonly diseased as the superficial vessels, the disease being most advanced where the intra-muscular veins empty their blood into either set.

Causes.—Certain conditions of system favor the formation of varices, congenital predisposition amongst others; a disposition thought by some to be hereditary. Very little is known about it. Persons with an indolent temperament, or persons reduced in health,[1] suffer from a relaxed and debilitated condition of the vein-walls, which lose their tone and their elasticity, and then offer little resistance to the pressure of the blood. In some cases, the heart's action is reduced in frequency (I have seen young adults in whom it beat but forty times in the minute) and in force, so that it slowly and with difficulty relieves itself of the venous blood. Such people, and others to a less extent, are more likely to suffer from varix if their occupation is one which habitually involves much standing or walking—in fact, any long-continued muscular exertion; and so cooks and grenadiers have been selected by Brodie and by Home as especially prone to the formation of varicose veins. They are developed chiefly during the active middle period of life; but their appearance may be postponed until old age, or may be referred to early life, since they not unfrequently occur in children under ten years of age.

Obstruction to the circulation is a passive aid to their formation. Hence they coincide with certain diseases of the heart, of the lungs, with cirrhotic liver, and are common when the portal system is overcharged with blood, as with those who *live well*, though such suffer more especially from varices of the rectum (hemorrhoids). Constipation involving the accumulation of feces in the intestine and pressure upon the iliac veins, the obstruction of veins with clots, the pressure of tumors, and such artificial pressure as that of an ill-adapted hernia truss or tight garters, may be enumerated as examples of conditions which retard the circulation, distend the veins, and prepare them to become varicose.

Such conditions have more influence upon the veins of the leg, because the pressure of the column of blood which these vessels have to resist is increased by gravitation. Although the column of venous blood ascending against its own weight, is supported by the column of arterial blood, yet the pressure of the fluid upon the walls of the veins increases by gravitation, inch by inch, towards the most dependent portions of the body. To illustrate this fact, the small intestine, freed from its mesentery, may be held so that its upper and lower outlets are upon the same level, the intermediate curve be-

[1] On the influence of gout, see Paget, St. Bartholomew's Hospital Reports, vol. ii.

[1] Specimens 254, 259.

[2] Further investigations confirm me in this statement. The various opinions on this and other points in the anatomy of varix are fully discussed in chap. i. of Mr. Gay's work On Varicose Disease. London, 1868.

ing pendent. If its canal is filled with water, it is easy to compare the lax conditions of its walls above with their tension, almost to bursting, at the curve below. In the veins this tension is relieved by valves, and some dilatation is permitted, as occasion requires, by their thin and yielding walls; but when the occasion passes by, the elastic vessels soon recover their natural capacity, and then the slightest force acting upon the blood-column tends to quicken its movement through the venous system. If there exist a tendency to dilatation by obstruction, such force, instead of moving the blood-column, is expended upon the vein-walls:[1] and if the force is represented by a certain quantity of blood forced into a vein, then there is added an increased tendency to dilatation by excess of contents.

In persons with relaxed and debilitated veins the varicose condition would seem to be determined by the habitual *over exercise of muscles*, especially those of the calf of the leg, which force the blood violently into vessels inclined to yield to the distension, and already over-filled by reason of a retarded or obstructed circulation. The dilatation which ensues is usually of slow progress; indeed, for a time the veins are often increased in thickness and strength to resist this distension; but Paré records cases, and his observations are confirmed, in which large varices have suddenly appeared after violent muscular exertion,[2] such as running, dancing, or carrying heavy weights. Wherever, so far as superficial varices are concerned, the intra-muscular veins pass into the subcutaneous, there the varix is first noticed; there the force, that is the blood-stream impelled from the muscles, tends to act on the vein-wall and to dilate the vessel; for the valves obstruct below, and the column of obstructed slow-moving blood resists above.[3]

The *anatomical changes* in varicose veins have been described by Andral; and his distinctions, though too minute, have been generally adopted.[4] In brief, it is sufficient to notice, that the coats of the dilated vessels may become thickened, or may become thin; that they may be lengthened, so that the veins are rendered tortuous; that the dilatation may be unequal, the vein being marked with pouches, which form at the sinus behind each valve, or result from the greater yielding of the vessel where the blood is forced into it from an intra-muscular branch; that varix of the femoral vein, which occasionally requires to be distinguished from a femoral hernia,[1] is thus formed by yielding of the vessel at its junction with the internal circumflex, saphena, and profunda veins.

As the vein-canal dilates, the valves, unless previously ruptured by violent and sudden muscular action, are unequal to close the passage; and, being useless, they presently waste and are reduced to mere fibrous bands, or disappear altogether.[2] The valves are not destroyed by the backward pressure of the column of blood obstructed in its passage to the heart; for they are adapted, as is well known, to resist this pressure, and they become, when needful, thick and strong, to fit them for doing so. But the force represented by the stream of blood advancing from below, and from the intra-muscular veins, presses upon their rear, and, as they are unable to resist a force acting in this direction, flattens their cusps against the vein-wall; and there, when the vein, from the combined action of several causes, has become so large that the valve-cusps are unable to meet and close its canal, they shrink and atrophy. It follows that, in varices, those valves only are thus destroyed which lie between the lowest varix and the heart; and, when they are destroyed, that the pressure of the blood-column, which they helped to resist, weighs more heavily upon the dependent and dilated vessels.

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[1] See experiments by Williams, Principles of Medicine, 2d edit., p. 188.

[2] Warren, op. cit. See also Malgaigne, Œuvres compl., t. ii., p. 268.

[3] Mr. Gay has elaborately considered the question of the cause of varicosity (see op. cit.). So far as I can judge, it seems desirable to assign as causes those mentioned in the text, especially the influence exercised by the intra-muscular veins upon the deep and subcutaneous systems of veins in the lower extremities.

[4] Varices: species 1. Simple dilatation, affecting the whole length of a vein, or existing only at intervals. 2. Simple dilatation, with thinning of the parietes. 3. Uniform dilatation, with thickening of the parietes. 4. Dilatation at intervals, with thickening at the dilated points; in this, and in the third species, the vessel being lengthened as well as dilated. 5. Dilatation, with the formation of septa, which divide the interior of the varix into many compartments, in which the blood coagulates. 6. The addition to the last of many small apertures in the walls, allowing the escape of blood, as in erectile tumors.—Pathological Anatomy, Eng. Trans., vol. ii., p. 4 et seq. Dublin, 1831.

[1] See HERNIA.

[2] Museums, Coll. of Surgeons, 1736, and Bartholomew's Hospital, series xiii., 79. Gay is of opinion, "As a rule, veins that become varicose are destitute of valves; and the cords which have been supposed to testify to their existence in these veins are referable to another source, viz., blood clot."—Op. cit., p. 105.

The tissues which surround the diseased veins become gradually absorbed in consequence of the continued pressure of the varix, and thus, as noticed by Hodgson,[1] bones even become indented. So thin, indeed, may the coverings of a varix become, that, with sudden exertion, or from a blow, they rupture, and hemorrhage ensues. In cases of long standing, however, it is usual to find the neighboring structures thickened and hard from simple œdema, or from inflammatory exudation, which, by involving the neighboring lymphatics, causes many of them to be permanently obstructed; so that, what with their obstruction and the obstructed vein-circulation, the whole leg becomes œdematous, and in time accumulates a great superfluity of fibro-cellular tissue, a condition which in severe cases is recognized as the Arabian elephantiasis.[2]

Varices of the lower extremity do not affect especially the left limb. The curious error which long prevailed, and gave precedence to the left leg, has been completely exposed. Statistics obtained by Verneuil, from cases observed at the Hôtel Dieu, show that one limb is diseased just as often as the other. In fact, the cases are rare, if they ever occur, in which the disorder does not affect both limbs simultaneously, although the greater progress in the superficial veins, which is observed in one limb, commonly causes the condition of its fellow to be passed by unnoticed.

Symptoms.—Though varices may exist for a long time, and cause little, if any, inconvenience, yet it is more usual for those who suffer from them to complain, some time before the external manifestation of the disease, of aching pain, deep seated in the limbs, with sense of weight, fulness, and fatigue, in some cases complicated with a certain numbness and even loss of power in the extremities. In a more advanced stage of the disease, the ankles swell after a hard day's work, and the feet are constantly cold. These symptoms indicate an embarrassed state of the circulation, to which is gradually added dilatation of the deep-seated veins, and more especially of the posterior tibial.

After a time, at one or more points in the leg, a small tumor, in an early stage resembling the "venosité" of Briquet, is formed, soft, of a bluish color, from the dark blood showing through the integument; it disappears on pressure, but returns when the pressure is removed, or when the patient stands up, and is caused by a vein which is dilating where joined by an intra-muscular branch. Around this tumor a series of minute vessels are clustered of a dark, bluish color—the small superficial veins through which the passage of the blood is retarded to a greater degree than elsewhere, because they open directly into that part of the vessel which is dilating. By degrees the dilatation extends and involves an increasing length of vein, and then forms irregular, knotty, convoluted tumors, soft and diminished in size by the horizontal posture, giving a bluish tint to the skin, which is stretched and thin, and surrounded by smaller veins, also somewhat varicose. These tumors are grouped around the points at which the dilatation first commenced, for the most part in the middle of the leg along the track of the external and internal saphena veins, but the clusters of tortuous vessels often extend along the entire length of the leg and thigh. To the symptoms already enumerated there is often added an unpleasant itching; and when nerve-fibrils are by chance involved, a sharp tingling pain.

Occasionally, when the varices gradually thin the skin which covers them, and burst through it, hemorrhage ensues, which may cause syncope and even death if not promptly arrested; for the valves being destroyed between the varix and the heart, the escape of blood is directly from the proximal portion of the vessel, and may be very considerable. In treating such a bleeding, the patient should be promptly laid on the ground, and the leg should be raised, when the hemorrhage will probably cease. If it continue, the pressure of a pad of lint applied to the bleeding vessel, and secured by a few turns of a bandage, will effectually arrest it.

In inflammation of the tissues around the veins we have the prelude to irritable conditions of the skin and eczema, to obstruction of the absorbents, and to ulceration;[1] and when the vein-walls from the same cause become surrounded with lymph, the condition is reached in which, as previously described, the vessels become filled with clots and obstructed. The knotty tumors are then hard and cannot be emptied by pressure, and this consolidation is permanent, for varicose veins once obstructed with clots never have their canals reopened. In this way the natural cure of a varicose cluster is often effected, with much temporary relief to the patient; as, however, the predisposition continues, and the exciting cause remains, other adjacent veins soon become involved, and perpetuate the disease.[2]

Treatment.—Varices of long standing

[1] Op. cit., p. 561.

[2] For erectile tumors, and their relations to varices, see NÆVI.

[1] For varicose ulcers, see vol. i., p. 376.

[2] See cases by Hodgson, op. cit., p. 561.

are inveterate; for although much may be done for their relief, they cannot be cured; and hence it is fortunate, although they occasion the patient much hurt and inconvenience, that they are not serious in their consequences. In their earlier stages they are more manageable; and it is much to be regretted that early symptoms are mostly unheeded, for whilst the disease is limited to the deep veins, or at most has involved but slightly the superficial vessels, it admits very readily of permanent benefit.

The management of the general health is an important item in the treatment of varices in every stage. The feeble and often ill-nourished patients who suffer from this disease, must be invigorated by tonics and a generous diet. The plethoric patient, with an embarrassed portal circulation, will gain much from often-repeated but small doses of purgative medicine, and by the use of cold saline baths. In each case some special symptoms will probably demand attention, and must be met by appropriate remedies; but in the large class of cases in which there exists a constitutional or acquired laxity of the veins, no remedy equals the tincture of the perchloride of iron, with an aperient pill every other night to obviate the occurrence of constipation. Under its influence, combined with proper local appliances, the laxity of the veins disappears, and the varices, if recent, are disposed of.

Provided always that the disease is not of long standing, and that local causes of obstruction, such as tight garters, are done away with, it is advisable, with this general treatment, that the legs should be rested in the horizontal position for at least a month or six weeks. Walking should be prohibited, and only carriage exercise allowed. The limbs, thus rested, should be bandaged from the toes to above the knee, the pressure being firm and equal, and the bandage (Domett) should be renewed daily. At the time of each renewal the limb should be well rubbed with the hand for about a quarter of an hour; by this treatment the circulation through the subcutaneous veins is rendered brisk, and the tonicity of the walls by degrees re-established. What with the inaction of the muscles, the improved tone of the superficial vessels, and the amendment of the general health, a good result may be anticipated.

But patients seldom have the inclination or the opportunity for submitting to such rigid treatment for the cure of a disease which causes comparatively little inconvenience; and when this is the case simple compression of the distended veins will often give great relief, and even prevent the disease from growing worse. Sufficient support may be obtained by merely bandaging the limb, greater pressure being made over the larger of the varicose clusters than elsewhere by means of a pad of lint placed upon each of them before the bandage is applied.[1] Elastic spiral bandages, or the elastic web stockings, are recommended as conveniently supplying the necessary support. They should be removed at night when the patient goes to bed, and replaced when he gets up in the morning. If any one of them causes irritation of the skin, it must be changed for some other; and it will often be found useful to protect the integument by means of flannel bandage or cotton wool before these appliances are put on. The most difficult to manage are the old varices surrounded by a quantity of indurated tissue, which protects them from the ordinary pressure; the difficulty may generally be overcome by the exercise of a little ingenuity in applying the supports. Travers cured a varicose cyst of the saphena by the pressure of strips of plaster. The varix should be emptied of its blood, and the strips, of a convenient length and breadth, should be then applied, crossing one another at right angles. A firm and even pressure may also be obtained by applying a wet bandage. A number of pieces of muslin, linen, or calico are prepared, each about two inches wide and twelve inches long, and saturated with water. Two of these strips are first placed beneath the foot, and their ends crossed over the instep towards the ankle. Other strips are then bound round the leg, their ends crossing in front, so arranged that the one above half-covers the one below, until the limb has been bandaged to a sufficient height. An ordinary roller is then placed over all, and each day the application is renewed.

These measures are, however, simply palliative; and in the desire to effect the cure of so common, and often troublesome a disease, many devices have, from time to time, been employed. With the exception of Herapath's suggestion for dividing the fascia lata at the saphenous opening to relieve a supposed pressure upon the femoral vein, they all aim at procuring obliteration of the varix, or the chief vein connected with it. But from all these measures it is quite certain that only a temporary benefit is obtained; for after one mass of varices has been removed, the anastomosing veins around soon acquire a varicose condition, and the disease is perpetuated. In deciding upon performing any one of the many operations open to choose from, it must be the relief, not the cure, of the varix which is antici-

[1] Local compression was first recommended by Delpech and Sanson. See Delpech, Maladies chir., tome iii.

pated; and no doubt there are cases, yet not so many as some would have us to believe, in which the pain of the varix, the impossibility of healing a large ulcer, the unfitting of a patient for his every-day work, justify the operation for the sake of the temporary benefit.

It has been objected to these operations, that they have sometimes imperilled the patient's life, and at one time they were brought into disrepute by the occurrence of several deaths from diffused inflammation extending along the course of the vein which had been operated upon; but the objection should be made, not to the operation, but to the performance of it upon patients in a bad state of health, who, to avail one's self of the quaint language of Dionis, are oppressed with humours always ready to cast themselves upon any one locality.[1] If the cases are selected with care, the judgment which decides in favor of an operation will never be reproached by the occurrence of serious hurt to the patient; and the only troublesome consequence will be a languid condition of the wounds, which, from the indolent circulation through the limb, are, as stated by Skey, often very difficult to heal.

The operations recommended for the local relief of varices are modifications of one another. Their practice dates from the earliest record of surgery, and some curious peculiarities of treatment may be referred to as showing the uncertain reasoning which regulated it. Thus, Celsus drew a distinction between straight and convoluted varices; for the first he recommends[2] that they should be exposed by cutting through the skin, and then destroyed by the actual cautery; whilst the latter he at once cut out with the knife. Ambroise Paré and Petit[3] punctured them, squeezed out their contents, and then applied a compress; but when the blood stagnated in an isolated tumor, they cut down upon and removed it. But, says Paré, old varices should be left alone, lest, being removed, the patient should be suffocated. Boyer followed Paré, but tied the vein above and below before opening it; and Home, after dividing the skin, passed a thread under the vein, and so tied the vessel leading from the varix towards the heart, under the impression that the blood, as it could no longer flow through the vessel, would stagnate, and then coagulate; and in practice Home found that varicose ulcers were thus more readily healed. From what has been here said respecting the causes of varicose veins, it is evident that no good could follow this operation; indeed, any benefit that patients obtained from its performance was probably due to the rest which it necessitated.

Amongst other suggestions, Fricke advised that two or three threads should be passed through the vein, after the fashion of a seton; and Capaletti[1] employed galvano-puncture to induce clotting of the blood within the varix; whilst Graefe[2] actually opened the vessels and filled their canals with lint. But all these methods were employed without any fixed idea of what was to be accomplished by their means.

Our object is now more definite, as we seek to relieve for a time this varicose condition by causing coagulation of the blood within the dilated veins, which then shrink and contract permanently. This result can be attained, 1st, by the action of caustics applied over the course of the vessel; 2d, by subcutaneous division of its walls; 3d, by compressing it between a steel pin and a twisted suture, or by some similar contrivance. The potassa fusa, or Vienna paste,[3] may be applied as recommended by Mayo, in quantity sufficient to cause sloughing of the skin over a varix, or the venous trunk connected with it. The tissues beneath the slough inflame, the vessel is filled with coagula, and so becomes obliterated. The slough should not exceed a quarter of an inch in its diameter, and the surrounding skin should be protected from the action of the caustic by a ring of plaster encircling the portion to be destroyed. Brodie recommends that sufficient caustic shall be employed to insure sloughing of the vein, as a more certain mode of securing its destruction, the vessel becoming closed and contracted above and below the slough. According to circumstances, two or more of these sloughs will be required, and in making them they must be carefully kept some distance asunder. Whether the varix is thus itself destroyed, or the venous track which passes from it, the blood which formerly passed through these vessels is driven into other channels, which gradually dilate into a fresh crop of varices.

Subcutaneous division of varicose veins is easily performed by means of a narrow pointed bistoury, first employed by Brodie,[4] which is introduced between the skin

[1] "Cocochymes et accablés d'humeurs, toujours prêtes à se jeter sur quelque partie."

[2] De Re Medicâ, lib. vii., cap. xxxi.

[3] Traité des Maladies chirurgicales, tome ii., p. 64.

[1] See Archives générales, 1848, p. 228.

[2] C. Bell's Surgery, German Trans., preface.

[3] Composed of five parts of quick-lime and four of caustic potash, made into a paste with spirits of wine immediately before its application. Nitric acid may be substituted when it is only required to excite inflammation about the vein.

[4] Lectures on Pathology and Surgery, p. 185.

and the vein, and is made to divide the latter as it is withdrawn. A compress of lint should be at once applied to restrain hemorrhage. This operation has the advantage of leaving a wound which heals readily, often by the first intention; but in some cases suppuration has followed, and in some it has failed to obliterate the vessel; so that, says Brodie, "it really appears it is not worth patients' while to submit to it. I have always observed, that if I cured one cluster, two smaller ones appeared, one on each side; and that ultimately I left the patient no better than I found him." If this operation is performed to facilitate the healing of a varicose ulcer, the vessel should be divided, if possible, below, so as to interrupt the blood as it streams in from anastomosing vessels and causes the distension of the veins about the ulcer. After this or any similar operation, the patient must be kept quiet in bed for at least four or five days, and longer if necessary.

Velpeau, following Davat, employed a metal pin, which he passed under (never through[1]) the vein, and on which he applied a twisted suture. The pin was allowed to remain in until sufficient inflammation had been excited to promote obliteration of the vein; but when the irritation which followed was but slight, the pin was left to come away by ulceration of the structures which covered it. Some of these pins he applied to the varicose clusters, and some to the veins communicating with them; and as no very bad results followed his operation, it was pretty generally tested. But, like others, it affords only temporary relief; and besides is open to the objection that the sores which result are often difficult to heal, although this is an objection more especially to the treatment by caustics. To prevent sloughing of the integument, it is recommended by some surgeons to protect it from the twisted thread by means of a piece of wax bougie. Various other devices for conveniently securing the obliteration, have from time to time been suggested.[2] A good and expeditious plan is that recommended by H. Lee, by whom it is thus described: "A needle is introduced beneath the vein or veins to be obliterated, and an 8-ligature is passed over its extremities. The vein or cluster of veins is thus included between the needle, which is below it, and the ligature, which is over the skin. The ligature is then tied so as to produce a slight degree of pressure on the vein, and by this means its cavity is temporarily closed by acupressure. Another needle is then passed under the vein at about an inch distance, and the vessel is there closed in like manner. The vein or cluster of veins thus included between the two needles is entirely separated from the rest of the circulating system, and may then be divided or otherwise obliterated without risk. Subcutaneous section of the vein is generally all that is necessary, and is preferable to any other mode of operating, as it effectually obliterates the vessels without leaving any open wound. At the expiration of about four days, when union is established in the divided parts, the needles are removed, having served their temporary purpose."

Except in cases which have been referred to, these operations are not to be recommended; and the patient, if wise, will be content with the palliative measures of a more simple character.

I have several times referred to tumors as causing obstruction to the circulation of the blood through veins. Little inconvenience follows, in consequence of the ready formation of a collateral circulation. Some tumors compress veins against a resisting substance, as bone; some by their growth completely surround them; whilst others extend into their canals, as was first pointed out by Langstaff in a case of medullary cancer. In many instances they cause obliteration of the vessel by interruption of its canal and by absorption of its coats, or they induce the formation of clots, by which it becomes permanently obstructed. Now and then a tumor appears to have its origin in and to be confined to a vein, as happened in the splenic, as recorded by Hodgson, and in a case, related by Andral,[1] where the growth consisted of adipose tissue in the wall of a portal vein.[2]

A few words will dispose of the subject of worms and other parasites which were

[1] Transfixing the vein and passing a thread through it, as proposed by Fricke, was found to occasion such great irritation that its use was presently abandoned.

[2] Metal pins for compressing veins are described in the Medical Times and Gazette, vol. ii., 1861, p. 377.

[1] Op. cit., vol. ii., p. 423.

[2] The following specimens give a good general idea of these vein obliterations. Middlesex, series vi., 32, 35: vena cava obliterated by pressure from an aneurism. St. Thomas's, y, 171: vein filled with encephaloid deposit. Guy's, 1521[65]: vena cava obliterated by the side of a dried-up hepatic abscess; and 1521[80], by pressure from enlarged glands. Guy's, 1522[7 15 25]: growths of cancer into superior venæ cavæ. St. Bartholomew's, 13, 29: fleshy growth between vena cava and kidney, obliterating the former. Aneurisms and abscesses, though they sometimes burst into adjacent veins, may also cause obliteration: St. Bartholomew's, 13, 84; St. Thomas's, y, 154; St. George's, vi., 128.

formerly supposed to infest veins. The more exact and minute examinations of the present day have refused in this matter to confirm many of the statements of the past. Parasitic animals, except in the cases of migration of the embryo of tænia, and in the instances quoted below, are rarely found in these vessels.[1]

DISEASES OF ARTERIES.

By Charles H. Moore, Esq.

Revised by Lewis A. Stimson, M.D.

Arteritis.

This is a rare disease. The most distinct instance of a limited arterial inflammation is that of the umbilical arteries, which after the ligature of the funis are sometimes filled with pus.

Inflammation of the aorta appears to have occurred in the practice of some physicians, and to have been traceable to the influence of cold. One such instance mentioned to me by my colleague, Dr. Goodfellow, followed upon a young man's lying for a long time upon his chest on wet ground. But the cases formerly described by surgeons as primary inflammation of arteries appear, by the light of later research, to have been due to the previous impaction of a plug. Inflammation of an artery, and even suppuration, may then take place, but it is a secondary disease, and it will be referred to in the section on "Occlusion of Arteries." Upon the cases in which long portions of artery are found obliterated and converted into fibrous cords, it may suffice to say that no evidence of previous arteritis or of any cause whatever can be adduced, and that the same result without obvious inflammation attends the obliteration of the ductus arteriosus, and sometimes follows the application of a ligature.

The diseases of arteries besides inflammation are few, and they are but in part distinguishable by the anatomical division of the coats. The outer coat may be involved in diseases of the sheath and of the intervening connective tissue, but, though yielding to scirrhus, and being sometimes perforated by it, that coat long resists the encroachment of medullary cancer, which may grow around it and form a tunnel for the vessel. A new growth, described by Dr. Moxon under the name of Periangeioma, is a rare instance of disease limited to the outer coat and sheath of arteries. It formed a tumor of the scalp, permeated by enlarged and tortuous vessels, and made up of new material occupying uniformly their outermost and circum-vascular structures.[2]

Diseases of the middle coat are probably only secondary to those of the lining

[1] Andral, Duval, Treutler, Fabricius, and Rudolphi, Virchow, and Leuckart, may be referred to. I find mentioned by one or other of these, echinococcus altricipariens and distoma hepaticum in the hepatic veins; acephalocysts in the pulmonary veins; strongylus and filaria in the veins of a horse; and entozoa belonging to the class nematoidea of Rudolphi in the right ventricle of a porpoise. Hæmatozoa, as they are termed, are said to be found in the veins of birds, reptiles, and fish, having perforated the vessels, as it is assumed, in their wanderings, and being then washed along the blood-stream until they stick in the capillaries. Leuckart, quoted by Küchenmeister (Syd. Trans., vol. i., p. 50), professes to have met on four occasions with the embryo of tænia migrating through the main branches of the vena porta. See also Siebold, Syd. Trans., p. 29.

The remarkable discoveries of Bilharz, Griesinger, Lautner, and others respecting the presence of small flukes (Bilharzia hæmatobia, Cobbold) should be referred to. They have been found in the portal system and in the veins of the mesentery and bladder. It is stated that in 363 autopsies "Greisinger found this entozoon present no less than 117 times." In advanced cases of the disease, as it occurs in Egypt and at the Cape of Good Hope, severe diarrhœa and hæmaturia precede death. Dr. Cobbold is so good as to inform me that he has discovered the same parasite in the portal blood of the Cercopithecus fuliginosus. The reader is referred for further details to Dr. T. Harley's paper in Med.-Chir. Trans., vol. xlvii.; or to Dr. Cobbold's treatise on Entozoa, p. 197 et seq.

[2] "Periangeioma of Scalp; excision; recovery." By Mr. Thomas Bryant. Trans. of Path. Soc., vol. xix., p. 376.

and external tunics of the vessel. The great hypertrophy of that coat, pointed out by Dr. G. Johnson, in the minuter vessels in cases of Bright's disease, or its dilatation in exophthalmic bronchocele, do not engage the special attention of the surgeon.

The most common disease of arteries is that of the inner coat, and it is of much importance in practical surgery, from its effects in weakening, enlarging, and occluding arteries.

[Arteries are subject to inflammation involving all the coats or only the internal or external. Acute endarteritis, inflammation of the internal coat, appears in the aorta in the form of raised, soft, pink patches of greater or less size, of regular outline, and usually circular. On microscopical examination these patches appear as thickenings of the internal coat produced by multiplication of its cellular elements, which begins in its most superficial layer, and is associated with the presence of a gelatinous intercellular substance, called *hyalin*, which is thought to be the product of a degenerative process. The surface of a patch may present ulcerations or fungoid overgrowths covered by a thin layer of fibrin.

In chronic endarteritis the process occupies the deeper layers of the internal coat, and gives rise to changes which will be considered in the section on atheroma.

Spontaneous acute endarteritis is not common in the small arteries; but a general arteritis, involving all the coats, is common in inflamed tissues, and may obstruct the lumen of the vessel by the growth of vegetations from its surface.

Periarteritis, inflammation of the outer coat, may appear as the accompaniment of an acute endarteritis, or alone, by the extension of neighboring phlegmon.

The middle coat may present changes secondary to periarteritis or endarteritis. The best known is a granular fatty degeneration associated with chronic endarteritis, and important in the production of aneurism. Some authors describe also a mesarteritis, beginning at the outer side of the artery around the vasa vasorum, and reaching its highest development within the middle coat.]

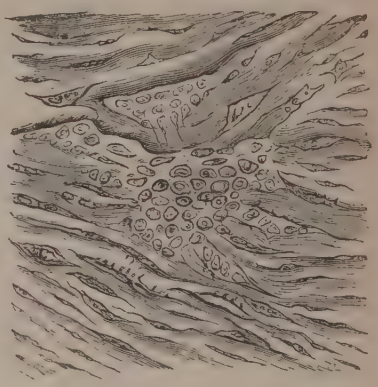
Atheroma.

In the earliest stage of atheroma a thin, soft, and clear membrane lines a part or the whole of an arterial tube. It is at first scarcely distinguishable from the natural inner coat of the vessel; its free surface has the shining smoothness of that membrane, and as it acquires firmness and a closer union with the original internal coat, it furnishes, in fact, a new lining to the artery. This structure is added to the artery without the slightest appearance of disease in the original textures of the vessel. Its coats are neither infiltered nor inflamed. There being no manifest cause in the artery itself for the formation of the new membrane, it may be looked upon as probably deposited upon the interior of the vessel from the blood.

This opinion as to its source is confirmed by the fact that the inner coats of an artery are devoid of nutrient bloodvessels, from which the new layer could be secreted, and by observing its further progress. On the inner surface of the new deposit, a stratum similar to the first is laid, and, like it, becomes consolidated, firmly adherent, and in its turn the foundation of additional depositions. When many of these strata have thus accumulated within the vessel, the whole mass is no longer transparent, but becomes opaque, dull, and condensed into a material similar to hardened albumen, and eventually to ligament. The layer last deposited may still be often detected, thin, smooth, soft, translucent, overlapping the edge of the deeper mass, and possessing, both in appearance and on microscopic examination, the characters of a lining membrane.

[The condition known by the name of atheroma is preceded and sometimes caused by fatty degeneration of the internal coat. It may also be caused directly by rheumatism, puerperal fever, or alcoholism, but even in these cases is accompanied by fatty degeneration. The first change is the appearance of pale opaque patches on the inner surface of the artery, which, under the microscope, are found to be due to granular fatty degeneration of the cellular elements of the deeper part of the internal coat, associated usually with the same degeneration of the middle coat.

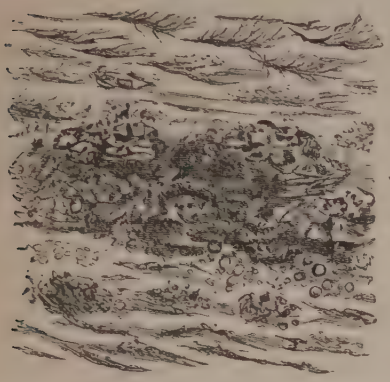
Fig. 306.



Vertical section of a recent patch of endarteritis (Bryant).

As the process advances calcareous salts are deposited in the same tissues, the fat granules coalesce to form drops and small cheesy masses, and a chronic end-arteritis is set up, the products of which undergo the same fatty and calcareous change. At this stage the appearance

Fig. 307.



Vertical section of an older patch, showing fatty and calcareous degeneration (Bryant).

presented to the naked eye is that of a slightly raised patch, with a pale border and a yellowish, sometimes depressed, centre, seen on vertical section to be covered by the same soft, clear layer which is found at the border. Under this smooth surface the patch is made hard and gritty by the calcareous salts deposited in it, and it contains a central focus of yellowish cheesy matter to which it owes the name of atheroma. The bottom of this focus is formed by the deeper layers of the internal coat.]

The coats of the artery are at first unchanged; but as the deposit accumulates their function is abolished; they waste, and lose their firmness, elasticity, and natural color. The fibrous coat turns to a dull yellow hue and softens, and it may be easily stripped off. With its natural texture, it loses its contractile power; it dilates, and is unequally thinned out, spaces being formed between its fibres, through which the deposit comes into contact and adhesion with the cellular coat of the vessel. The outer membrane at first becomes unnaturally vascular, swollen with infiltration, and manifestly inflamed. As the activity of this process subsides, it is converted into a callous, white membrane, closely adherent to the deposit and to the remnant of the middle coat.

One of two changes may occur in such an indurated lining plate of an artery. It may soften in its interior, or be converted into a layer of cretaceous matter.

Both the softening and the change into bone take place in the deeper parts of the deposit. In the former process it degenerates into a thick pulpy mass of cholesterine, oil-globules, and albuminous and cretaceous molecules. The inner strata separate this pulp for a time from the blood; but when they give way, the whole is gradually washed out into the stream, and the base of the cavity, composed of the weakened walls of the artery, is exposed to the impulse of the blood. The possible occurrence of an aneurism, particularly a dissecting aneurism, in this condition of the vessel, will be evident.

Cretefaction, or ossification, likewise occurs only in a thick deposit, and in its external, oldest layers. The inner surface of a bony plate of an artery is for some time lined by the most recently laid stratum of membrane; but if at length this also ossifies, the plate is exposed in the vessel. Externally, nothing intervenes between the plate and the middle coat, for the original lining membrane partakes in the chalky degeneration. The bony growth varies in its form in different specimens, and still more in different arteries. In the aorta, the innominata, and the common iliac, it assumes that of plates of different sizes, irregular in outline, generally concave and smooth internally, rugged and convex externally; whilst in smaller arteries it grows in the shape of rings, which answer in their position and direction to the yellow circular fibres, and have been regarded as ossifications of that coat. In some of the larger arteries, a rough mass of bone may even project into the canal, a growth of so peculiar an aspect as to be compared by Professor Rokitansky to stalactite.

[Cretefaction and ossification are not synonymous terms, and only the former is applicable to this condition, which is characterized by the deposit of lime salts. Bone-corpuscles, whose presence alone would justify the use of the second term, are not found in it. The plates are calcareous, not bony; and as their edges are thin and sharp, they sometimes cut through this covering, and render possible an infiltration of blood into the wall of the vessel.]

The extent to which atheroma affects the system of bloodvessels is very various. In some instances, every artery sufficiently large to be named by anatomists is thus diseased; in others, certain vessels or parts of vessels are unaffected by it. Extensive atheroma of the aorta is almost invariably attended by disease of the other arteries; or, to state the same fact in the form in which it is usually presented to the surgeon, if the vessels of the limbs are found diseased, it may be presumed that those within the trunk are in a similar condition. It is necessary to

note the instances in which the disease is limited.

The aorta may be diseased throughout, yet the coronary arteries may be healthy; and it is interesting to contrast the highly nourished state of the heart in such a case with its condition when its nutrient arteries are diseased. The aortic valves, the commencement or the whole of the arch, may be atheromatous, and no other vessel be affected. Isolated patches of the disease may occur between long tracts of healthy artery, and it is of the greatest importance in surgery to know this fact in relation to the popliteal and axillary arteries, of which short portions may be even ossified, while the femoral and subclavian, so far as concerns the possibility of their being successfully tied, are healthy. When at all advanced, the disease is found to be symmetrical, the arteries of opposite limbs being equally and similarly affected. This fact is well illustrated in the not unfrequent occurrence of parallel, almost contemporaneous, popliteal aneurisms in the same person. Some vessels are earlier, if not more frequently, affected with the disease than others. There is such a preponderance in the lower extremity over the upper, both in the proneness of its vessels to the disease, and in the degree which atheroma attains in the more distant limb. Some entire arteries rarely become atheromatous. Those of the stomach, liver, and intestines, are remarkably exempt from this affection, even though it may have attained an advanced degree in the splenic and the other arteries of the body. As a general rule, atheroma is a disease of the arterial trunks and larger branches, but it is occasionally met with in very small vessels. On one occasion, when making horizontal sections in the ordinary mode of examining a brain, I found all the minute vessels ascending through the central white matter of the cerebrum converted into stiff wires of bone, the first incision of which blunted the knife. Haller once met with an atheroma in the hypogastric artery, but it is the only case on record. The most marked exemption, however, is that of the venous system, including the pulmonary artery and its branches; and it is a very suggestive fact in reference to the causation of the whole disease. Atheroma, even in its early stage, is rarely found in the vessels which carry venous blood; and when it does occur, it is associated with extensive disease in the aortic system.

So marked a difference in the liability of the two systems of vessels to this disease might seem to point to their structure as its cause, and lead to the error of regarding it as an affection of the middle coat of the arteries. But that a mere difference of structure cannot account for the exemption of the venous system is evident from the facts, that the contrast between the two systems is continued into the heart itself, that the deposit in cases of arterio-venous aneurism is at least as abundant in the vein as in the artery, and that it is readily formed within the pulmonary arteries, when a preternatural communication admits arterial blood from the left to the right side of the heart. It appears clear therefore that the source of the morbid material is arterial blood. It is further observed, that the disease prevails chiefly in persons who are in the decline of life, and is associated with a defective nutrition of the normal structures of the body, with arcus senilis, and with an accumulation of fat.

An attempt has been made to connect it with the inordinate use of alcohol; and there can be no question of its frequent, if not invariable, occurrence in drunkards. There must exist, however, some more hidden fault in the formation or purification of the blood, to which, rather than even to alcohol, the disease must be attributed. Young found calcareous concretions in the arteries of an infant; Wilson in a young child; and Andral in the aorta of a child of eight years of age. The latter author also met with ossific laminæ in the aorta in five or six persons of from eighteen to twenty-four years of age, and an extensive ossification of the superior mesenteric artery of a person not quite thirty.[1] Corfe records an instance of fatal aneurism, as arising from this disease, at the age of twenty-eight;[2] and in the Hunterian Museum, No. 1679, is a specimen of it in no alcohol-drinker, but in a jaguar. The gouty, the aged, the rheumatic, the person whose tissues are imbued with fat, and those whose excretory organs fail to purify the circulating blood, are far more prone to the disease than the phthisical, the cancerous, or the young. Soldiers appear to be more than usually prone to atheroma, and consequently to aneurism. The arterial deposit is in them rather compact and leathery, and does not easily pass into the stages of softening or of ulceration. This form of disease is surmised to be one of the products of syphilis, which is apparently more than alcohol a source of blood disease in these otherwise healthy men.

The microscopic examination of the white and buff-colored deposits shows them to be chiefly composed of granules and oil-globules. Mr. Gulliver first described them as containing cholesterine, oleine, and often some margarine.[3] Chemical investigations of the bony plates, by Dr. Bostock, proved them to contain "a minute trace of albumen and gelatine,

[1] Copland, Dict. Med., vol. i., p. 119.
[2] Physiognomy of Diseases, p. 129.
[3] Med. Chir. Trans., vol. xxvi., p. 90.

animal matter, much phosphate of lime, a little carbonate, and a trace of sulphate."[1]

The atheromatous change in an artery is slow in its progress, and can only when far advanced be detected in the living subject. It is occasionally attended with persistent pain, which is liable to be mistaken for a rheumatic pain. When actually ossified, an artery which can be felt at all may be readily distinguished as thus diseased. In the radial, for instance, rings of chalky matter can be recognized as the finger is moved along the vessel. But attention is often first called to the state of the arteries rather by some secondary symptom of their disease than by the atheroma itself.

1. Atheroma is at first attended with a narrowing of the calibre of the vessel, in proportion to the thickness in which it is deposited. This is most marked at the bifurcation of trunks, and at the mouths of small vessels passing off from large trunks. In no spot is it more commonly observed than at the origins of the intercostal and similar arteries, which branch off at right angles from the aorta, and which are sometimes not only narrowed, but at last completely closed, by the accumulated deposit. Though the larger arteries are perhaps never obliterated by this process, yet even they may be much contracted by it. The canal of so large a vessel as the common iliac has been found diminished by one-half,[2] and the great ascending branches of the arch of the aorta nearly obliterated.

Of the latter occurrence, Dr. Yelloly recorded an instance. A man, aged fifty-six, who was supposed to be in health, but who had suddenly fainted two or three times in the two years preceding his death, fell and died while at work in his garden. The arch of the aorta was dilated and atheromatous, and the three great vessels ascending from its arch were in a considerable degree plugged up with a growth similar to the lining membrane of the artery, and without any bony deposit.[3]

A diminution of the size of branch-vessels from this cause may prove to be of serious importance in some cases, by hindering the establishment of a collateral circulation.

2. A later consequence of the disease is dilatation of the vessel. The outer coats being incapable of compressing the deposit, and closing in upon the blood after each cardiac systole, they fail to contract during the diastole, and the artery gradually expands. This enlargement is the most marked in those parts of the vessels through which the current of the blood is in any degree obstructed. All curved arteries, therefore, are disproportionately dilated. It is observed also in all parts at which an arterial trunk naturally widens in its course, and suffers in consequence a more forcible internal hydraulic pressure than the smaller tube which leads to it. The upper extremity of the common carotid is thus widened naturally, and dilated when atheromatous. In that situation, at the upper end of the innominata, and in the higher part of the femoral artery, the expanded vessel may claim attention as an aneurism.

3. The same mechanism which converts an artery into a fixed tube, incapable of contraction, but liable to dilatation, produces a similar effect upon its power of retraction. A healthy artery is in a state of longitudinal tension. It is, as it were, too short for the limb to which it belongs; and, if cut across, may shorten an inch or more.[1] Atheromatous and bony plates destroy this retractile power. But though incapable of shortening itself, the vessel may be lengthened by the repeated injections of blood along it. Arteries, therefore, in which atheroma has reached an advanced degree, become not only dilated, but also tortuous. The outline of brachial arteries thus affected may be seen in the bare arm, every pulsation of the heart increasing their curvatures. The common and external iliac arteries, too, bend far from their normal position, the former arching outward and forward between the aorta and external iliac, the latter leaving its place upon the psoas, and curving deeply into the pelvis in a new course.

4. An ossified artery does not retain that smoothness of its interior which characterized the earlier deposition within it. In a large vessel like the aorta, a bony plate may crack across, or be lifted at its edge from the wall of the vessel; and the sharp rough projection thus exposed may cause the adhesion of fibrin. Strings and masses of this substance, as it accumulates, materially lessen the cal-

[1] Med. Chir. Trans., vol. xix., p. 87.
[2] Hunterian Museum, 1614.
[3] Med. Chir. Trans., vol. xii., p. 576.

[1] An artery *may* shorten to this extent. I have observed the ends of a torn brachial artery, in a boy of thirteen, to have separated more than an inch and a half when the elbow was extended. On the other hand, a cleanly divided healthy common femoral artery, preserved, with the adjacent structures, in the Hunterian Museum (No. 1568), has neither retracted nor contracted. The wound is stated to have caused fatal hemorrhage. It may be remarked in explanation, that the brachial artery is very loosely connected with its sheath, and is not fixed by branches; while the common femoral is a short trunk, and rather intimately adherent to its sheath.

ibre of the vessel, or, being broken off, and carried along with the stream of blood, plug any small artery in which they happen to be arrested. The ossification of smaller trunks, as the femoral arteries, produces in another manner a roughness of their canal. The bony matter being thickest, or sometimes only existing, in circular rings, the vessel is strongest at those parts, while it yields between them. The interior of such a vessel is consequently no longer smooth, but is formed of a succession of alternate transverse ridges and bays; the former answering to the rings of bone, and the latter to the expanded spaces between them. Such an artery resembles the interior of a piece of jejunum, into the canal of which folds of the valvulæ conniventes project; and the effect of the arrangement, just as in the bowel, must be to retard the current.

5. It has been already mentioned that an atheromatous artery becomes dilated, and that it may yield and become aneurismal at a part from which the softened deposit on its interior has been washed away. It may be added, that the so-called ulcers of arteries, which are occasioned by the partial detachment or the cracking of calcareous deposits, "are sometimes so deep as to reach, and even to perforate, the external or cellular tunic."[1]

But, even without such previous detachment of its inner portion, a diseased artery may be torn through by the direct force of the blood. Dr. J. Risdon Bennett has recorded a case of sudden death, in which the aorta gave way before the impulse of a hypertrophied heart. The "rupture was directly through all the coats of the artery; the edges of the aperture were somewhat ragged, and traversed a patch of atheroma."[2] Messrs. James and Rose have published similar cases of spontaneous rupture of the aorta, and Mr. Arnott one of rupture of a diseased aorta from violence.[3]

It is obvious that these accidents are more liable to occur, as the disease is limited in extent. The artery yields at its one weak point.

6. In relation to accidents, and surgical operations on arteries, atheroma assumes a serious importance. No longer tense, mobile, elastic, these vessels become rigid, brittle, and fixed. A direct blow may crack or crush them; a severe wrench, or sudden unusual movement of a limb, may half break them; the violence which dislocates a bone may tear them in two, and give rise to a vast escape of blood. Mr. Syme alleges that he has known an axillary aneurism follow such accidents as the repeated sudden shock of a machine against the elbow, and a quick unguarded movement in lifting the arm to the head for the purpose of holding on the hat in a breeze.

When a ligature is tied upon an ossified artery, the sensation conveyed by crushing the bony tube betrays its condition. Sometimes the artery gives way. In the stump of a leg just amputated, I have seen an ossified tibial artery break three times under the ligature. The vessel was only secured at last by including a large quantity of the adjacent soft parts in the noose with it. In another case the ligature was wound several times round the artery. The difficulty experienced in safely tying such a vessel, has suggested the plan of dissecting along the artery, and placing the ligature on it higher up. As it is uncertain whether such an artery would be better adapted to bear a ligature in any higher part of its course, the safer plan seems to be that of securing it in the face of the stump. Such a case would be better treated by the ligature than by acupressure, but would be unfitted for torsion.

To atheroma and ossification are doubtless due the majority of the failures of operations for aneurism. Notoriously is this the case with the old operation, in which the artery was tied near the mouth of the aneurismal sac. And many times also, when the Hunterian operation has been adopted, the result has been disastrous from the same cause. The process of repair cannot be perfected in a tied artery, when the lining membrane is tough, or osseous, or in a state of fatty degeneration, when the middle coat is wasted, and the outer callous and attenuated, and when the rigid tube is incapable of contracting between the ligature and the next branch. From such an artery the ligature separates, perhaps earlier than from a healthy one, and hemorrhage pours freely and fatally from one or both of its unclosed extremities. A prudent surgeon forbears from operating in such a case, or from tightening the ligature if he unexpectedly encounter a diseased vessel.

7. Gangrene may occur at different stages, and from various circumstances, in the course of atheroma; but, in itself, that disease is not capable of producing gangrene. For, so long as the vessels remain open, even though rigid, they allow blood to pass. And, in fact, any obstruction which may be occasioned by the roughness, is, to some extent, compensated for by the dilatation of their canal, and the distal parts obtain their nourishment. But should any unusual and con-

[1] Hope, Cycl. of Pract. Med., vol. i., p. 145.
[2] Med.-Chir. Trans., vol. xxxii., p. 161.
[3] London Med. and Phys. Journal, vol. lviii., pp. 15, 19; and xviii.

siderable demand upon the circulation be made by a local injury or inflammation, the circulation will prove insufficient; and, as trees with tangled roots sometimes perish in a night upon a sudden increase in the rapidity of the flowing of the sap, the distal parts will die. Gangrene is often extensive when an ossified arterial trunk becomes occluded; and the explanation of the fact appears obvious. The collateral channels, through which alone the blood can reach the remoter parts, are themselves indurated or ossified, and are incapable of adapting their calibre to the larger stream which presses through them. The unnourished structures necessarily die. These occlusions of arterial trunks are not such as are very slowly completed by the accumulation of new matter at their orifices or bifurcations, but such as arise from the more rapid deposition of large masses of fibrine upon a rough part of an artery, or from the loosening and inversion of an osseous plate, or the washing of a detached cardiac vegetation down the current. The first, occurring comparatively early in the disease, can be made up for by the establishment of a collateral circulation; the others happen suddenly, in which case even healthy collateral arteries sometimes fail to preserve the life of a limb.

Occlusion of Arteries.

Some other causes of obstruction to the current of blood remains to be noticed, besides those by atheroma.

There are persons who, by certain postures of their limbs, are able to stop the pulsation of their arteries. The radials and tibials cease to beat upon forcible flexion of the elbows and knees. Others can so depress the clavicle upon the subclavian artery, or raise that vessel by a forcible expiratory compression of the lungs, as to arrest circulation in the arm. Arteries displaced with fragments of bone are often without pulsation until the fracture is set. An exuberant osseous deposition around the fragments of a fractured bone may, it is alleged, compress adjoining bloodvessels. The situation in which this has been observed to happen, is the fibrous canal in the adductor muscles of the thigh. I have myself seen such obstruction of the femoral, and gangrene of the limb, only where the artery itself was injured, or the fracture had not been replaced.

In like manner, that is to say, by outward compression, morbid growths in the vicinity of bloodvessels enfeeble or stop the circulation. An exostosis once grew on the first rib in such a relation to the subclavian artery as to give rise to the symptoms of an aneurism of that vessel, and lead the surgeon who had charge of the case to tie the artery. Cancerous, and more rarely the innocent, tumors compress and obliterate arterial trunks, which are found flattened, and either pervious or occluded with coagula or adherent fibrin. Even gangrene may follow the occlusion of an artery from this cause. This, however, is a rare event, as time elapses before the compression becomes complete, and blood, in some small quantity, continues to be driven through the flattened vessel. The obliteration of aneurismal vessels will be found explained at large in the essay on Aneurism.

One other cause of the occlusion of an artery remains for consideration, that, namely, in which its canal is closed by an impacted foreign body. The cases are now numerous in which arteries have been found plugged by fragments of morbid growths, which have been detached from one part of the circulating system, and transported into some other part along the stream of blood. The plug which is found occluding the distal vessel has often no organic connection with its walls, and is detained in its place merely by having reached an artery too small to give it further passage. The accident is usually met with in the aortic system, and the most common situation from which such fragments are detached is the left side of the heart. Many morbid vegetations adhere to the mitral and aortic valves loosely or by pedicles, and may be broken off by the rush of blood into or out of the ventricle. Some, but smaller, fragments may, as Mr. Lee suggests, be washed out of atheromatous parts of the larger vessels.[1]

So long ago as 1837, it occurred to M. Legroux[2] to explain a case of sudden obstruction of the arteries of the lower extremities by the passage of the fibrinous plugs found in them from the heart. A similar explanation was given by M. Laugier to the Anatomical Society of Paris, in 1849, respecting a yet more remarkable case. A healthy young man died with a needle in the left ventricle of his heart, and with gangrene of the left leg. The needle was found fixed in the apex of the ventricle, with its point directed towards the aortic orifice, and covered with "decolorized sanguineous concretions, very coherent and irregular," which were prolonged into the aorta. The lower end of the aorta, and the iliac arteries on both sides, were filled with an adherent clot. It seemed plain that the plugging of the latter, and the conse-

[1] Lee, on "Gangræna Senilis," British and Foreign Medico-Chirurg. Review, vol. xx., p. 214.

[2] Bulletin de l'Acad. royale de Médecine, tome i., p. 434.

quent gangrene, had their origin in the detachment of fragments of the lymph which had first adhered to the needle.[1] Since that time the researches of Dr. Kirkes have shown a similar occurrence to take place in the cerebral arteries. Mr. Paget has demonstrated it in the pulmonary arteries; and Virchow, Simpson, and others, have made us acquainted with it in other vessels.

An accident precisely similar in its nature, but occurring in another portion of the circulating system, is now known to be occasionally fatal in acute rheumatism, as well as to bring on the most fearfully sudden deaths in some puerperal women. The plugged artery in these cases is the pulmonary, or several of its branches, and the plug is either formed in the right side of the heart, or passes through it from the systemic veins.[2]

The facts from which the explanation of these occlusions of arteries is chiefly drawn, have already been partly stated: 1. The artery is often healthy at the site of the obstruction. It may, indeed, be atheromatous, inasmuch as the occurrence in question prevails most in persons whose arterial system is diseased. Yet it is often healthy, as might be expected if the disease originated elsewhere. Sometimes the vessel is dilated to nearly twice its natural size, and, in the branches of the internal carotid especially, this enlargement renders the situation of the plug evident before the artery is opened. 2. The plug is frequently not adherent to the vessel. The cases under consideration were for a long time regarded as effusions of lymph from the surface of an inflamed artery; but when the artery is healthy, and the plug free, that explanation is plainly erroneous. There are, indeed, not a few instances in which the coats of the artery are inflamed, and even suppuration has taken place in the surrounding structures; in these circumstances, the plug is found adherent. The inflammation, however, and the adhesion, are alike the result of the previous presence of the plug. 3. The impacted plug can be distinguished from the inflammatory lymph and coagulum which are formed in its immediate neighborhood. Drs. Burrows and Rühle have given the most undeniable evidence of this fact, and have all but demonstrably traced the plug to another place of origin. Each of these observers detected a calcareous plug occluding an artery, and similar calcareous matter still attached to the wall of the heart.[1] 4. The cessation of the circulation in the occluded artery is too abrupt to have arisen from a gradual accumulation of fibrin. It has probably not always been discovered to be instantaneous, because the pulse has not been under examination at the moment of the occlusion. 5. The severe pain which first calls attention to the accident, and death, as it happens from such obstructions of the pulmonary artery, are both sometimes sudden. 6. After loss of sight from this cause, the twigs of the retinal artery are seen with the ophthalmoscope to be bloodless upon the distal side of the plug.

It would far exceed the limits of this article to trace the results of this accident in the various parts and organs of the body in which it has been shown to occur. As there is no trunk which may not be occluded by a detached plug, the abdominal aorta itself not escaping, so there is no organ which may not have its function impaired, or its structure destroyed, by the deprivation of blood which this accident occasions. Organs with single arterial trunks, as the testicle, retina, or spleen, may lose their function when thus deprived of their whole supply of blood.

When the principal artery of a limb is suddenly plugged in its higher part, severe pain is commonly the immediate result of the accident. In some cases this pain extends along the course of the vessel, which, though pulseless, is extremely tender; in others the suffering is referred to some distal part of the limb, as, for instance, to the calf. Signs of a deficient circulation succeed; and they may amount to pallor, loss of temperature, numbness of the surface, or even to that "torpor" which in certain injuries of vessels is observed to precede the total death of a limb. Such torpor implies not only a loss of circulating blood in the limb, but also a cessation of feeling and motor power, and it may issue in actual mortification.

It is not every case of obstructed artery which terminates in gangrene. A collateral circulation may be established, and the life of the limb be saved. Very young subjects bear such an accident without any ensuing mortification. An infant will endure without loss of life the gradual obliteration of even the aorta itself at the termination of its arch. Mr. Savory has recorded an instance, probably congenital, in which "all the main arteries of both upper extremities and of the left side of the neck were reduced to solid cords;" yet no gangrene occurred.[2]

[1] Cruveilhier, Traité d'Anatomie pathologique générale, tome ii., pp. 201, 296, 388.

[2] Obstetric Memoirs, by Sir James Y. Simpson and his editors, Drs. Priestley and Storer, vol. ii.

[1] Medical Times, 1853, p. 135; Virchow's Archiv, vol. v., p. 189.

[2] Medico-Chirurgical Transactions, vol. xxxix., p. 214.

The subjects of gangrene from an impacted clot have a general feebleness of the system, which may account for the progress and great mortality of it. Some persons die before any line of demarcation is formed; more sink during the process of separating the dead portion of the limb; a few survive until all its tissues are naturally severed, except the bones and some tendons. Upon the division of these, the stump may heal.

Some at least of the obscurity which invests the subject of *senile gangrene* is cleared away, if obliteration of some of the arteries be recognized among its causes. There are commonly preliminary symptoms which may have indicated arterial disease; chilliness of the foot, or hand, and frequent pains for many months, forebode the attack, and the gangrene at length originates and advances by a local dusky inflammation. In these particulars the gangrene of the aged is unlike that which is suddenly produced in younger subjects by obstructed arteries, but sometimes an arterial cause of senile gangrene can be traced.

Treatment.—The occlusions of arterial trunks which are caused by external compression can rarely be relieved. For innocent tumors seldom interfere with the circulation, being rather themselves grooved by an artery than compressing it; and malignant growths, when they have reached a size and a position in which they can produce such an effect, are commonly unsuitable for an operation. No special suggestion is required for the treatment of arteries implicated with broken bones, and none can be offered for their compression in certain situations by the growth of new bone about the fragments. The chief attention will necessarily be claimed by the manifest cause of the obstruction, at the same time that all efforts must be directed to preserving the life of the limb by warmth and a suitable posture.

In the treatment of arteries suddenly occluded, it may be possible at an early stage by reasonable pressure to break up a soft recent plug in a superficial vessel, that its fragments may pass into arteries of less importance to the limb. If this be not possible or proper, care must be directed to preserve the temperature of the limb, to favor the establishment of a collateral circulation, to maintain the efficiency of the blood by suitable nourishment, to relieve pain by methods which will least interfere with the appetite, and, more than all, to guard the weakened limb from irritation, and injury, which might overtask the little vital power it still retains: these are the indications before the occurrence of gangrene. When that event has commenced, the course advised in the essay on that subject must be adopted. If the mortification advance slowly, as in senile gangrene, Sir B. C. Brodie's recommendation of a calamine cerate to the sloughing parts, and then swathing the entire limb for two or three days at a time in a very thick layer of cotton-wool should be adopted; it avoids exposure, and quiets the mind of the patient. Poultices make the parts warm for a time only, and must be frequently renewed, whilst cotton-wool preserves the limb at an equable temperature, and need not be disturbed until the discharges from the part require removal.

[In a case of gangrene of the leg following ligature of the external iliac artery (The Lancet, Aug. 4, 1877), Mr. Oliver Pemberton succeeded in keeping the parts dry and inoffensive for many weeks by wrapping them in cotton-wool saturated with a solution of carbolic acid in ether; finally, the deeper tissues of the calf became putrid and moist, but the foot and ankle remained dry throughout, until removed ninety-two days after the operation.]

The administration of opium is essential in these cases, on account of the severity of the pain, and some patients preserve a clean tongue and a fair appetite whilst taking it. Others, however, cannot continue to take it by the mouth, who can yet procure refreshing sleep and other benefits by the subcutaneous injection of a little morphia.

The question of diet and stimulants in cases of gangrene, especially senile gangrene, has been warmly discussed. The advocates of an animal diet assert that any treatment which deteriorates or diminishes the blood in the system, and therefore in the limb, is promptly followed by an extension of the mortification, and that the patient is strongest, and consequently the life remaining in the limb best maintained, with such nourishment, if only its quality and amount be rightly adapted to the digestive powers of the patient, and those powers be kept in proper order. With Sir Benjamin Brodie,[1] they advocate the administration of stimulants in moderate quantity; that is to say, "any quantity of wine that does not occasion heat of skin, nor raise the pulse, nor make the mouth clammy, nor render the patient nervous or irritable, may be given with advantage; but whatever does more than this, does mischief." On the contrary, the advocates of a very sparing farinaceous and vegetable diet assert that it checks the gangrene, whilst an animal diet and stimulants cause it to extend. The discrepancy between the two opinions,

[1] Lectures in Pathology and Surgery, p. 368.

which have both been entertained by practical men, is probably to be explained by Sir B. Brodie's caution not being observed. If these patients take opium and animal food, it is essential for them to have a calomel purgative every three or four days. Without such a precaution the stomach may be disordered and the gangrene spread; but both these evils are avoided in curable cases if the precaution be observed.

The offensive odor emitted by the gangrenous parts should be overcome by dry powdered charcoal freely sprinkled amongst the cotton-wool. Scales of pure iodine, contained in chip-boxes, and covered with muslin instead of a lid, are still more effective for the purpose. Being inodorous, it may be hung about the bed. Larger boxes of wood, with perforated zinc lids, and filled with sawdust and carbolic acid, may also be put into the bed. The suggestion of the iodine is from Mr. Hoffman of Margate.

Should the gangrenous limb be amputated? Surgical experience and reasoning both prompt a general reply in the negative. In many cases, the obstruction of the artery is higher than the site of the proposed operation, as, for instance, in iliac arteries or the aorta. Amputation in such circumstances can only be done below the cause of the gangrene, and in parts which are ill-supplied with blood. Moreover, if the operation be performed on a level with or above the obstruction, as when the popliteal only is plugged, it is often unsuccessful; there still remains the constitutional exhaustion, the natural or the premature old age, or the disease of the heart, under the influence of which the patient has to rally from the shock of an amputation. And further, the instances are not few, especially amongst the younger subjects, in which, on mortification ceasing, the dead parts spontaneously slough off. Except in special circumstances, therefore, amputation should not be performed. The various events are illustrated in the following two series of selected cases; the first showing gangrene in the aged, and the second in younger subjects.

1. Gangrene attacked the arm of a middle-aged lady, who died exhausted in a few weeks, before the separation of the dead parts was complete.—A man, aged seventy-two, was attacked with inflammation at the back of the left hand, which ended in black dry gangrene. In six months death had spread, without causing pain, as far as the elbow; and in twelve months more, to the shoulder. The limb was hard, as black as smoked meat, and without cadaverous smell. In another month the arm dropped off without hemorrhage, and the wound healed without discharge. The man was alive and pretty well four years afterwards.[1]—Mr. Guthrie amputated low in the thigh for gangræna senilis extending to the knee. The femoral artery was plugged at the groin. The stump did not slough; but the patient, an elderly lady, after a partial recovery, sank exhausted before it healed.[2]—Mr. Langstaff amputated a thigh for mortification of the leg in a man aged seventy-five. All the vessels were ossified, and could not be tied so as to stop the flow of blood. The patient, already much exhausted, died within twenty-four hours.[3]—Dr. A. P. Thomson reported a case of amputation in the thigh for dry gangrene of the leg in a woman aged sixty-five. The arteries were pervious to the popliteal. The patient sank on the third day.—A man, aged seventy, died seven weeks after amputation in the thigh for gangræna senilis. It was unnecessary to tie any vessel in the operation; all were already plugged.[4]—Amputation in another case was survived for a time, but the soft parts took on no reparative action; they shrank and retracted from the end of the femur, and the patient died.—Mr. James, of Exeter, amputated in the thigh for senile gangrene. The operation was followed by "constant tremor and subsultus, muttering delirium, and the sweat of relaxation;" yet the patient, a man of sixty-eight, eventually recovered.[5]—Some successful cases of amputation in senile gangrene were related in a discussion at the Royal Medical and Chirurgical Society of London, in 1853. Mr. Garlike, of Rickmansworth, had removed the thigh, near the trunk, four months after the commencement of gangrene at the toes, the patient in the course of his disease having likewise suffered from suppuration in the leg and in the knee-joint. Mr. Adams had seen a man, over sixty years of age, recover after a similar operation. Such cases are, however, rare, and cannot be accepted as establishing a general rule of practice. Under peculiar circumstances, as in Mr. Garlike's case, amputation may be performed; but all that the other cases appear to show is, that the operation may possibly not be fatal in a few instances in which the strength of the patient is not much reduced, and the gangrene has existed for an unusual length of time. These, however, are just the few cases which may be capable of a spontaneous separation of the dead parts; the great majority of cases of extensive senile gangrene end in death, whether the limbs are amputated or not.

Two cases of gangrene of the lower extremity, in comparatively young subjects, proved fatal in the Middlesex Hospital; the one under the care of Dr. Stewart, the other of Dr. Goodfellow. The heart, and the whole of the arteries implicated in its disease, have in each

[1] Alix, Altenburg, 1778; quoted from Mason Good, Medicine, 1st edit., vol. ii., p. 919.

[2] Hunterian Museum, 141.

[3] Med. Chir. Trans., vol. vi., p. 193.

[4] Hunterian Museum, 2822.

[5] James, On Inflammation, p. 552, 1832.

case been preserved as one continuous preparation, which exhibits at a glance the pathology of the occurrence: vast fragile polypi in the left cavities of the heart, and detached fragments of the cardiac mass plugging several of the arteries. In neither case had the ulcerative process deeply severed the dead and living parts.—My colleague, Dr. Seth Thompson, requested me to see a girl, of twenty years of age, whom he had admitted into the Middlesex Hospital, on account of a rheumatic disease of the heart. She had loud mitral and aortic murmurs, acute adhesive inflammation of the right posterior saphena vein, and a red, tender, and exquisitely painful swelling at the lower third of the right leg. This inflamed patch had not suppurated; but the pain in it was intense, and destroyed her rest. An incision relieved her, and after a few days a slough of fascia separated, and the wound healed with remarkably little suppuration. Inflammation was next observed in the left posterior saphenous vein. Anasarca in both legs followed, and the face became puffy. After a fortnight of great pain and much general depression, the left foot and leg became cold and dusky, and the ends of the toes shrivelled and turned black. Complete gangrene of the lower half of the leg ensued, and a line of demarcation formed. When nothing remained to divide but the bones and a part of the tendon of the gastrocnemius, I separated them, and removed the fetid limb. The stump had nearly healed when she left the hospital.—A seamstress, aged seventeen, ill-nourished, had acute spontaneous gangrene of the foot and the whole leg. There was no pulsation in the femoral artery. After amputation, the stump and the groin sloughed, and the patient died. But one small artery needed a ligature in the operation, and the iliac artery was found plugged.[1]—A native Christian of Salsette, aged thirty-five, was affected with spontaneous gangrene of the arm, and in eighteen days ulceration had deeply separated the dead and living parts at the elbow, and had extended along the integuments half way to the shoulder. The limb was amputated about four inches below the shoulder joint, and the man recovered.[2]—A gangrenous leg was removed by amputation in the thigh from a puerperal woman, aged twenty-five. Not a drop of blood flowed at the operation, and the patient died the next day.—In another patient, aged thirty-nine, gangrene of the foot took place after parturition, the thigh was amputated three months after the delivery, and the patient recovered.[3]—A man, aged thirty, suffered from an "epidemic malignant fever," which brought on a mortification of the left foot. When ulceration was going on about two inches above the ankle, the leg was amputated below the knee. No blood flowed in the operation; but the stump suppurated healthily and the man got well.[4]

[It must be remembered that the gangrene in some of these cases is due not to impaction of a clot, but to thrombosis. I have seen this occur in the third week of a typhoid fever, and prove fatal after amputation, in a woman of 24.]

ANEURISM.

By T. Holmes, Esq.

Revised by Lewis A. Stimson, M.D.

Pathology.

An aneurism is defined to be a tumor containing blood, and communicating with the cavity of an artery. Thus in every aneurism there are two parts to be considered, the sac[1] and its contents. The sac is formed either by the vessel itself, dilated from disease, or by the condensed soft parts in the neighborhood.

The various classifications of aneurism now in common use are based upon varieties in the anatomy of the sac. The most natural nomenclature appears to me to be

[1] Some authors speak of extravasations of blood among the tissues of a limb, from the giving way of an artery, as "diffused aneurisms;" but this appears to me an error. I should term this lesion "a ruptured artery." The distinction, as I hope to show, is not a trivial one.

[1] New York Journal, Sept., 1854, case 6.

[2] Hunterian Museum, 2835.

[3] Simpson's Obstetric Memoirs, edited by Drs. Priestley and Storer, vol. ii., pp. 46, 47, cases 23, 25.

[4] Medical Observations and Inquiries, 1764, vol. ii., p. 152.

that which calls an aneurism formed by the coats (one or more) of the artery a true aneurism, and one formed by the surrounding cellular tissue a false aneurism. Unfortunately the term "true aneurism" was applied by the older authors to a tumor in which all the coats of the vessel were dilated, while they called one in which only one of the coats formed the sac "a false aneurism;" a very inappropriate name, inasmuch as such aneurisms form the majority of those met with in practice, while the term "false" appears to convey the idea of something exceptional and peculiar. It is undesirable to complicate the matter still further by the attempt to introduce fresh terms. I shall therefore adhere to the old nomenclature, in spite of my opinion of its incorrectness; merely observing that these anatomical refinements are of very little importance in practice; that no one troubles

Terms used in this Essay.	Broca.	Erichsen.
I. Common or encysted aneurism. The tumor forming a single sac, communicating with a single artery at a single point.	Circumscribed aneurism.	
Subdivisions:—		
(*a*) Aneurismal dilatation or fusiform aneurism. The sac formed by all three coats of the artery dilated over a great extent.	This is excluded from Broca's classification.	Fusiform or tubular aneurism.
(*b*) True aneurism. The sac formed by all the coats of the artery dilated at only one point.	True aneurism.	True sacculated aneurism.
(*c*) False aneurism. The sac formed by only one of the coats of the artery.	Mixed external aneurism; subdivided into *sacciform*, *fusiform*, and *dissecting*.	Circumscribed false sacculated aneurism.
(*d*) Consecutive or diffused aneurism. All the coats of the vessel have given way, and the sac is formed out of the neighboring parts.	False, or encysted aneurism; subdivided into primitive and consecutive. Cystogenic aneurism; formed by a cyst developed in the thickness of the walls of the vessel, and afterwards communicating with its cavity. This is not recognized in either of the other classifications.	Diffused false sacculated aneurism, under which he also includes extravasations without a sac—our ruptured aneurism or ruptured artery.
II. Arterio-venous aneurism, formed by a direct or indirect communication between an artery and a vein.	Arterio-venous aneurism.	
Subdivisions:—		
(*a*) Aneurismal varix; in which the communication is direct, no tumor being formed.	Aneurismal varix, or simple phlebartery.	Aneurismal varix.
(*b*) Varicose aneurism; where the communication between the vein and artery is through the intervention of a tumor.	Varicose aneurism. Two forms described; the one in which the tumor is formed by a dilatation of the vein (varicose aneurism by dilatation); the other in which the sac is a new formation—encysted or false consecutive varicose aneurism.	Varicose aneurism.
III. Cirsoid aneurism; formed by the convolutions of a single dilated artery.	Arterial varix.	Arterial varix.
IV. Dissecting aneurism; an affection of the vessel occasioned by ulceration of its lining membrane, and effusion of blood between the coats.	Dissecting aneurism, considered by Broca as a variety of false aneurism. Broca describes two kinds of "diffused" aneurism, by which he means aneurisms without a sac. This, according to us, is a contradiction in terms. Broca's first form of diffused aneurism is described in this work as "rupture of an artery;" his second as "rupture of an aneurism."	Dissecting aneurism. The same remark applies to Erichsen's classification.

himself as to how many coats of the artery enter into the formation of a sac, or has any means of forming an opinion on the point before dissection. But it is very important to ascertain whether the blood is contained in a sac or no, whether that sac is or is not perfect, and whether the aneurism is of spontaneous or traumatic origin.

The term "diffused aneurism" is also, I must confess, an inappropriate one as used to describe a tumor in which the sac is formed out of the cellular tissue; since such a tumor is as distinct and circumscribed as if the sac were formed by the vessel itself; and accordingly in many works an aneurism is said to be diffused when the sac has given way. Such an affection, however, is equally well or better described as "a ruptured aneurism." The term "diffused," serves indeed to remind us that the blood, though now encysted, was once diffused among the neighboring parts; but as it is liable to be confounded with the same term as used by other authors to designate extravasations from rupture, I shall prefer to use in the sequel the name "consecutive aneurism" for such aneurisms as have the sac formed out of the tissues external to the vessel. In order as far as possible to avoid ambiguities, a Table is subjoined, showing the nomenclature adopted in this essay, as contrasted with that hitherto common in France and England: M. Broca's treatise being used as an example of the former, and the chapter on Aneurism in Mr. Erichsen's Science and Art of Surgery for the latter. (See the Table, p. 314.)

The kinds of aneurism to be described below are as follows:—

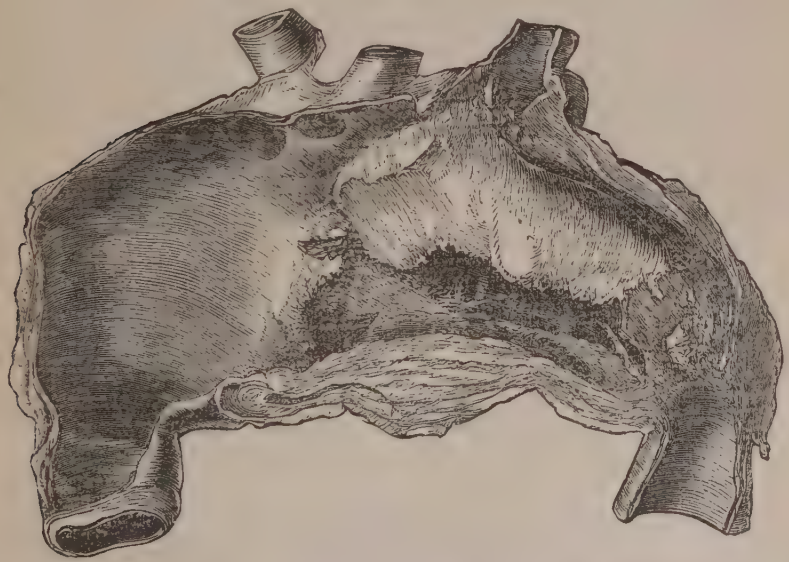
1. Common or encysted aneurism, subdivided into—
   (*a*) Fusiform aneurism, or aneurismal dilatation.
   (*b*) True aneurism.
   (*c*) False aneurism.
   (*d*) Consecutive or diffused aneurism.
2. Arterio-venous aneurism, subdivided into varicose aneurism and aneurismal varix.
3. Cirsoid aneurism, sometimes called arterial varix. Aneurism by anastomosis will be considered under this head.
4. Dissecting aneurism.

Common or Encysted Aneurism.

By common or encysted aneurism is meant that variety of the disease, embracing by far the greater number of cases, in which the tumor is formed of a single cyst, communicates only with a single artery, and is limited to a single point of the course of that artery. Some of the subdivisions of this affection are practically very different from each other, while between others the difference is unimportant, and in fact usually inappreciable during life.

In the *aneurismal dilatation* or *fusiform aneurism*, the whole circumference of the artery has yielded to the force of the cir-

Fig. 308.



Fusiform aneurism, or aneurismal dilatation, of the aorta, half filled with laminated coagulum. (From the Museum of the Royal College of Surgeons, No. 1641.) To show the possibility of the deposit of clot in such aneurisms, and even of spontaneous cure, with preservation of the channel of the vessel.

culation for some considerable length of the vessel, and so a tumor has been developed, of an elongated or somewhat cylindrical shape, continuous with the cavity of the artery at each end. The coats of the vessel are generally much thinned and highly atheromatous. This form of aneurism hardly ever contains much clot. It is of more common occurrence in the aorta, but rare in the arteries of the limbs; the most usual situations below the aorta being the innominate, the top of the common carotid, and the inguinal portion of the external iliac and femoral (p. 307). Some authors separate the aneurismal dilatation entirely from the category of aneurisms, and treat of it as a

Fig. 309.

A small aneurism of the radial artery (Museum of the Royal College of Surgeons, No. 1697) to show the usual shape and relations of a common or encysted aneurism, which stands out like a bud from a portion of the circumference of the vessel.

distinct disease; but no pathological distinction can be made between this and other forms of dilated artery which would not be subject to endless exceptions and modifications, and in practice this affection is often indistinguishable from the "true" aneurism.[1]

True aneurism is defined to be a circumscribed dilatation of an artery in a part only of its circumference, in which all three coats of the vessel are dilated to form the sac, while in a (so-called) *false* aneurism the two internal coats have given way and disappeared, and the sac is formed only by the external, or cellular, coat. The true aneurism, like the aneurismal dilatation, of which it may be regarded as a variety, is much more common in the aorta than in any other vessel; so much more so that Scarpa denied that true aneurism exists in any other artery. It is difficult, however, to refuse credence to the numerous authorities who have described the dissection of small incipient true aneurisms of other arteries in which the several coats could be actually demonstrated; but at a later period they become consolidated together at the neck of the sac, and the internal layers cannot be followed further, having been worn off by friction, if they were ever present; at this period, therefore, there is no appreciable difference between one aneurism and another as to their mode of formation. Even if the two internal coats can be followed for some little distance beyond the opening into the aneurism, this does not prove that it is a true aneurism, since the part of the internal coats which can be traced may be merely that which would have lined the opening, and which has now been everted into the sac. The presence of a smooth, shining membrane lining the sac is no proof that the tumor is a true aneurism, since such pseudo-epithelial laminæ are very often found in new formations,[1] and particularly where constant motion has been taking place. So that it is impossible to perceive any difference between true and false aneurisms at the time at which they generally come under observation; and it is not worth while to say more on the subject, beyond stating that the true become false as they grow; and expressing an opinion, founded on the manner of their origin, that false aneurisms are far the most common.

[The results of recent study of the mode of formation of aneurisms confirm Mr. Holmes's opinion concerning the difference sought to be established between "true" and "false" aneurisms. Aneurismal dilatation seems to be preceded by a change in the inner and middle coats consisting in a hyaline degeneration of the former (see p. 304), and a disintegration or degeneration of the elastic lamellæ and

[1] Some amount of dilatation, associated usually with atheroma, is constantly met with in the arteries of persons advanced in life; but this hardly constitutes a tumor, and so does not deserve the name aneurismal. The arteries also become tortuous as well as dilated in elderly persons of relaxed fibre, and it seems, from the account of a preparation by Mr. Coulson (Path. Soc. Trans., vol. iii., p. 302), that this condition sometimes simulates an aneurismal tumor. The patient was a woman aged eighty-eight, who for some years before her death had had a pulsating tumor, the size of an orange, just above the right clavicle, in the situation of the carotid. It had been taken to be aneurismal, but on dissection it was found that "the vessels arising from the aorta were elongated, and considerably dilated; and the tumor consisted of a reduplication of the common carotid and of indurated cellular tissue around it."

[1] See Prescott Hewett, in Med.-Chir. Trans., vol. xxix., p. 80.

muscular fibres of the latter. This disintegration diminishes the resistance of the arterial wall, and is followed by its expansion under the pressure of the blood. The thickened and altered intima is forced into the opening thus formed, and constitutes the inner surface of the sac, supported by the adjoining tissues and, in the early stages at least, by the remains of the two other coats. The details of the process have been observed by P. Meyer in the small aneurisms of pulmonary cavities; his observations are recorded in the Archives de Physiologie, Juillet–Août, 1880.]

Another form of false aneurism is described by authors of credit, and must therefore be noticed here, although its reality is doubtful. It is sometimes called "hernial" aneurism, and the sac is formed by a projection, or hernia, of the two inner coats, or some portion of them, through a rent or an ulcerated opening in the external tunic. Whether the cases which have been put on record really prove the existence of this affection, must be left to the reader to decide for himself. It is a point rather of curiosity than of practical interest.[1]

The other form of encysted aneurism is the *consecutive* or *diffused*, in which all the coats of the artery (or, as frequently happens, the sac of a previous aneurism) have given way, and the blood is effused into the cellular tissue. The latter soon becomes condensed, and forms, with the muscles, ligaments, viscera, or bones in the neighborhood, a sac for the blood, frequently distinguished from those of the previous varieties by being multilocular. The great majority of aneurisms are, if the terms be strictly construed, of the consecutive form; since few tumors of long standing will be found in which some part, at any rate, of the sac has not been borrowed from surrounding tissues.[2]

Such are the varieties of common aneurism, classified according to the anatomy of the sac. Other principles of classification have been proposed. Thus, some surgeons prefer dividing aneurisms, according to their form, into tubular, sacculated, and dissecting;[1] and frequently aneurisms are named, according to their cause, traumatic or spontaneous. Each method of classification is occasionally useful; but the anatomical arrangement is most generally adopted.

Causes of aneurism.—In general terms it may be said that anything may be a cause of aneurism which destroys the balance that ought to exist between the expansive force of the circulation and the reaction of the artery, so as to make the former preponderate. But none of the ordinary events which are looked upon as exciting causes of the disease can produce it without a predisposing cause in the condition of the artery itself. This condition is, in the great majority of cases, the result of *atheroma;* but on that state of the arteries enough has already been said, and the reader is referred to the previous section. Any other cause which produces a partial atrophy of the artery renders it liable to dilatation at the atrophied part: Vidal[2] remarks that the accidental exposure of an artery which ought to be deep-seated may induce aneurism, both by weakening the coats of the vessel, and by depriving it of the support of the soft parts. Unnatural and long-continued pressure may produce the same effect. Thus, a case is recorded in which the pressure of an exostosis produced aneurism.[3] The frequent occurrence of aneurisms in both popliteal arteries strikingly proves the origin of the affection in disease of the arterial system; the same thing is even more strongly shown by a case which is recorded of the formation of a popliteal aneurism in one ham, while the man was in bed for the treatment of an aneurism in the opposite ham. In extensive disease of the arteries, a great number of aneurisms may form, constituting what is called the "aneurismal diathesis."[4]

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[1] There is a preparation in the Museum of the College of Surgeons intended to show this form of aneurism. Mr. Erichsen, however, reports, as the result of his examination of this specimen, that he believes the external coat not to have been originally deficient, but to have been dissected off; Cooper's Surgical Dictionary, 8th edition, 1861, p. 140. In this opinion I quite concur. The line at which the external coat has been cut away, is distinctly marked all round the neck of the sac. M. Broca expresses his disbelief in the reality of hernial aneurism.

[2] I would wish, at the risk of being accused of repetition, again to remind the reader that the term "diffused aneurism" is very often applied to a *ruptured* aneurism, and even to a ruptured artery, *i. e.*, to cases in which the blood is poured out into the cellular tissue, and infiltrates a great part of the limb without the formation of any sac. But I think that I shall be able to show reasons for saying that it is more correct, and is of considerable practical importance, to separate these cases altogether from cases of aneurism properly so called, and to limit that term to tumors provided with a sac.

[1] Luke, in Lond. Med. Gaz., May 9, 1845; Erichsen, in Cooper's Surgical Dictionary, 8th edit.

[2] Traité de Pathol. externe, 1851, vol. i., p. 645. The instance which he gives is one of exposure of the femoral artery in hospital gangrene.

[3] Roux, Quarante Années, etc., vol. ii., p. 131.

[4] Broca (Des Anévrismes et de leur Traitement, p. 52) instances, among other cases of

It often happens, however, that aneurisms are found in arteries which appear healthy in all other parts of their course; and this seems to be more frequently the case, the farther the disease is from the heart. In these cases the nature of the predisposing cause is unknown. It has been alleged that mercury and syphilis predispose to aneurism; but the assertion appears gratuitous. The abuse of ardent spirits is certainly an exciting cause, and may possibly produce some weakness of the vessels, so as to entitle us to consider it also as a predisposing cause. It is worthy of notice that the disease is almost unknown in early life;[1] that external aneurisms (*i. e.*, aneurisms of the limbs) are very rare among women, especially in the higher ranks of life;[2] and that such aneurisms are found most commonly upon those arteries which are most affected by the movements of the joints; while aneurisms generally are most common at those points where the flexure, or the division of a large artery, opposes some sort of check to the blood-stream. The arch of the aorta, especially at the dilated portion called the "sinus magnus," and at the transverse bend, is the most familiar example of aneurism occurring at the flexure of an artery; while the dilatation of the end of the common carotid, the common aneurism of the lower part of the popliteal, and the tumors which affect the cœliac axis of the abdominal aorta, usually at the root of one of its branches, will illustrate the effect of division. The aorta, popliteal, and axillary artery seem most liable to disease, as being the most constantly subject to stretching, and the two latter to forcible rupture. The constant impulse of the blood-stream against the arch must keep the root of the aorta in more active motion than any other part of the arterial system.

The influence of forcible motion on the popliteal artery is shown by an experiment of Richerand.[1] On a dead subject let the bones of the extended leg be forcibly driven down into the ham till the ligaments are heard to crack. The middle and internal coats of the popliteal artery will be found torn. It is true that the accidents commonly cited as causes of aneurism are not so severe as this rough proceeding; but slighter injury to the artery probably occurs, and lays the foundation for subsequent dilatation.

Again, the heart is often hypertrophied, as the consequence either of disease or of the habits of life of the patient; and where the artery is weakened by any of the above causes, it can no longer resist

multiple aneurisms, one under the care of Pelletan, in which sixty-three were found in the same body.

[1] A few cases are, however, on record. Mr. Hutchinson found an aneurismal cavity connected with the aorta of a child four years of age, which he was inclined to attribute to the ulceration of a tuberculous abscess into the artery (Path. Soc. Trans., vol. v., p. 104). Mr. Syme has operated for aneurism at the age of nine (Lond. and Edinb. Monthly Journ., 1844); and a case of rupture of the aorta in a child aged seven and a half years, probably preceded by the formation of a small aneurism, is recorded by Dr. Armitage (Path. Soc. Trans., vol. ix., p. 85). Mr. T. Smith tied the external iliac artery for femoral aneurism with success, at the age of twelve. See Brit. Med. Journ., March 16, 1867, where a few other cases are referred to.

[2] Internal aneurisms seem equally, if not more common among women, when their way of life exposes them to the vascular excitement consequent on intemperance, vice, and mental emotions. Thus Dr. Rendle informs me that aneurism is a more common cause of death amongst female than male prisoners. This is shown by the annexed table, compiled from the records of the Queen's Prison, Brixton, all the inmates of which are prisoners under long periods of sentence.

Number and Proportion of Deaths from Aneurism of Convicts under Sentence of Penal Servitude, from January 1, 1854, *until December* 31, 1868.

Daily average number of Convicts during the fifteen years 1854–68.		Number of Deaths from all Causes.		Number of Deaths from Aneurism.	
Men	Women	Men	Women	Men	Women
6042.7	1059.4	1291	214	8	5

Deaths from Aneurism, calculated on a daily average of 1000; during the fifteen years 1854–68.		Percentage of Deaths from Aneurism, of the total number of Deaths during the fifteen years.	
Men	Women	Men	Women
1.3	4.7	0.61	2.33

[According to the 47th Annual Report of the Registrar-General, 685 persons died of aneurism in England in 1874; of these 537, say 89.5 per cent., were men.]

[1] Nosog. Chir., vol. iv., p. 73. Hodgson, On Diseases of the Arteries and Veins, ed. 1815, p. 64. In repeating this experiment, I have found that this is only occasionally true. I have sometimes found the artery entire; and on one occasion the external coat was somewhat lacerated, while the others remained entire.

the increased impulse. Hence aneurism is regarded, with at any rate much probability, as a mechanical effect of the wearing out of the artery by use; the circular muscular fibres which constitute the strongest part of the wall of the vessel being, according to this theory, stretched, and partially separated. The fact that aneurism affects the systemic arteries only, *i. e.*, only those vessels which convey red blood, has led some authors to believe that the formation of these tumors may depend in some unknown manner upon the quality of the blood conveyed by the artery. With our present knowledge of vital chemistry it would be absurd even to affect to give an opinion upon the possibility of this. It seems quite sufficient to state that the pulmonary system receives the force of the right ventricle only, which is seldom hypertrophied, and which, at its strongest, is perhaps incapable of generating the expansive force necessary to produce aneurism.

A case of aneurism of the pulmonary artery is on record in which the ductus arteriosus was pervious, and so red blood was admitted into the artery. But it is not impossible that the force of the left ventricle might have been reflected along the open duct.[1]

A more unmistakable case of pure aneurism of the pulmonary artery is the following, for which I am indebted to Dr. Rendle:—

The patient, a young woman, appeared in perfect health, when she was suddenly seized with acute pain beneath the left scapula. In two hours there was emphysema of the side; this rapidly extended over the back, chest, neck, face, arms, and even as far as one wrist. About three weeks after, she brought up blood, and died immediately. The left bronchus was pierced by a small triangular opening close below the bifurcation, from which the air had escaped. The cartilaginous rings were bared and ulcerated from pressure of an aneurism of the pulmonary artery. The aneurismal sac was very small: not larger than a horse-bean.

In some persons affected with the so-called "aneurismal diathesis," the whole arterial system shows an extraordinary tendency to aneurism, without, as is said, any visible anatomical peculiarity in the vessels; but in ordinary cases of this diathesis the vessels are evidently soft and weak.

When, by any of these predisposing conditions, the wall of the vessel is sufficiently weakened, it will give way at the weakened part to the force of the circulation, and all the more surely if that force is temporarily increased by any unusual circumstance, which thus becomes an exciting cause. Hence, perhaps, the frequent occurrence of aneurism in persons of dissipated lives, and in persons who follow laborious occupations; by which not only is the heart's action unduly increased from time to time, but also the arteries of the limbs are exposed to frequent shocks. Hence violent mental emotion sometimes gives rise to aneurism.

Two cases of aneurisms of the abdominal aorta, dating in each case from the time of the patient's receiving sentence for a criminal offence, have come within the experience of Dr. Rendle, Surgeon to the Brixton Prison, who has favored me with the following note: "A strong healthy woman, five feet eight inches high, who had never before been in prison, received a sentence of transportation for life. *Immediately* on receiving sentence, and whilst standing at the dock, she almost fainted from terror, was suddenly seized with severe pain in the epigastric region, and fell into the arms of an attendant. The pain in the epigastric region never entirely ceased; and just six weeks after, a pulsating tumor of small size was readily to be felt. This increased in size, until it was as large as the closed fist. She lived for three or four years, being constantly kept in bed and under treatment, and then passed from under my care. Three or four months afterwards (*i. e.*, five years and two months after her sentence) she was found dead in bed. No post-mortem examination was performed, but the aneurismal nature of the tumor admitted of no question. This case was so clearly traceable to the shock consequent on receiving a heavy sentence, as to leave no reasonable doubt of the immediate cause of the disease.

"The second case was also an aneurism of the abdominal aorta at the cœliac axis, and came on after receiving a severe sentence, though I could not trace it so distinctly to the sentence as in the first case. When I discovered this tumor—the woman only complained of obscure pain in the part, and was at her work when I saw her—it was about the size of a small orange. I sent her at once to the infirmary, and had her put to bed. *Twelve hours* after being in bed, the aneurism ruptured, and she died in forty-eight hours. I made a post-mortem examination. Both patients were women between thirty and forty years of age, and otherwise healthy."

Occupations which necessitate constant exercise of a limb, and frequent strains upon its joints, act both as predisposing and exciting causes of aneurism in the arteries lying near such joints. Popliteal aneurism seems to be caused in very many instances by the giving way of the circular coat of the vessel under the alternate movements of forced extension and violent flexion, to which that artery is exposed in the movements of the knee. Suppuration near an artery may lead to the

[1] On the connection between the quality of the blood and the deposition of atheroma, see the section on that head.

formation of a consecutive aneurism, the wall of the vessel being perforated by ulceration, and the blood admitted into the sac of the abscess. This seems to be a very rare event; but suppuration around an artery may also act as a predisposing cause, by denuding the vessel, as has been already pointed out. Unmistakable instances, however, of abscesses converted into aneurisms are on record.

Mr. Liston's case is well-known,[1] in which he opened a cyst communicating with the internal carotid artery, believing it to be an abscess, and in which he was obliged, in consequence of the gush of blood that followed the puncture, to place a ligature on the common carotid. The patient died of secondary hemorrhage, the result of the operation; and on post-mortem examination Mr. Liston found reason to believe that the disease was originally an abscess which had established a communication with the artery. Whatever may be thought of the real nature of the tumor in that case, there can be little doubt that several of the other cases which are related in Mr. Liston's paper were genuine instances of communication between abscesses and arteries.[2] These abscesses may be the result of struma, cancer, or common inflammation. In the 34th volume of the Medico-Chirurgical Transactions is a very interesting case by Mr. Dixon, in which a hydatid cyst, having been laid open, sloughed, and so established a communication with the subclavian artery. The patient died of hemorrhage. This is the ordinary result in cases of ulceration penetrating arteries. No aneurism is formed, since there is an open wound. But, in the rarer cases, such as those referred to above, the suppuration proceeds subcutaneously, and a consecutive aneurism is formed. Possibly Mr. Liston's case may have been an example of this event; but the diagnosis must be allowed to be doubtful. The following instance was one in which the artery gave way without any known cause, there being no clear history of abscess, nor any violent effort or injury to account for the laceration. A man aged twenty-nine was admitted into St. George's Hospital for a large purple swelling at the back of the pharynx, accompanied by swelling and much discoloration on the front and left side of the neck. Two days before admission, the patient, while kneading some bread, felt a stabbing pain near the hyoid bone. In three hours' time the throat was so swollen that he could not swallow food, and dyspnœa came on. After a short stay in the hospital, the diffused swelling of the neck became circumscribed, hard, and smaller. There was evident pulsation of the tumor, with a whirring sound, which only became perceptible as the tumor diminished in size and became harder. The patient went on well for a month, the tumor becoming reduced to the size of a walnut, when suddenly it increased in size and extended in various directions. The general beating of the tumor gradually disappeared, leaving merely a line of pulsation in the course of the carotid. Great difficulty of swallowing followed immediately; the tumor became more and more tense, and the symptoms increased. The patient died of dyspnœa six days after the sudden increase in the tumor. The parts are in the hospital museum. In the preparation, immediately below the bifurcation of the carotid artery, is a small opening in the vessel surrounded by a few minute patches of atheroma. There is a large pouch formed by the cellular tissue and fibrin of the extravasated blood, which completely pushes the larynx and trachea over to the right side, and encroaches much on the cavity of the larynx. There is no distinct rupture perceptible in the sac, but it is extremely thin at one point. It is formed chiefly by blood-clot, the fibrous investment of which is very thin.

[1] On a Variety of False Aneurism. London, 1842. An interesting case of fatal hemorrhage from communication between an abscess in the neck and the aorta is recorded by Mr. Busk, Med.-Chir. Trans., vol. xxix., p. 297.

[2] It may not be out of place to notice here the extraordinary omission in Mr. Liston's paper of any reference to auscultation as a means of diagnosis. He admits that, before he made his puncture, he had received "a hint that the tumor might in some way be connected with the carotid;" yet he never seems to have listened for a bruit. Had he done so, there can be little doubt that it would have revealed the existence of a communication with the artery. An interesting case of aneurism which had been sent into hospital as an abscess to be opened, and in which the diagnosis was made by auscultation, is related by M. Richet in his article on "Aneurism" in the Dict. de Méd. et de Chir. prat., vol. ii., p. 309.

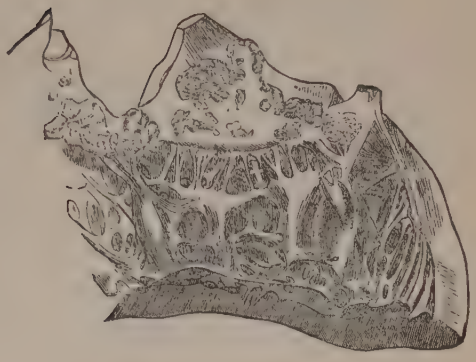
It seems probable that the impaction of a clot of fibrin in the artery may lead to its dilatation behind the obstruction, and thus to the formation of an aneurism.

Mr. Tufnell has put on record[1] a remarkable case, in which a pulsating tumor formed in the ham, in a patient who was dying from rheumatic disease of the aortic valves. The tumor subsided, with simultaneous enlargement of the collateral branches; and after death the artery was found plugged with fibrin and somewhat dilated. In this case it seems clear that the artery, being healthy at the part where the clot became impacted, yielded to the force of the (hypertrophied) heart to such an extent as to form a tolerably large pulsating tumor, but that, as the collateral circulation enlarged, it was enabled nearly to recover its healthy dimensions. Such a case is illustrated by the accompanying figures, showing an aneurism which formed on the ulnar artery of a lad, aged 17,

[1] Dublin Quarterly Journal, May, 1853.

Fig. 310.

Fig. 311.



Aneurism formed by embolism. Fig. 310 shows an aneurism of the ulnar artery; *a*, *b*, the artery, its lower end closed by clot; *c* the sac partly filled with coagulum; Fig. 311 shows the deposit on the lining membrane of the heart.

who died under Mr. Pollock's care at St. George's Hospital in the year 1864. The deposit on the valves and the embolic clot in the kidney are also shown. The spleen was

Fig. 312.

A block of fibrin deposited in the kidney in the same case. (From a drawing in St. George's Hospital Museum. Series xxi., No. 60.)

similarly affected. The artery in other parts was healthy.[1] If the same accident were to take place in an artery enfeebled by atheromatous degeneration, no doubt the aneurism would go on increasing.

The objection which has been urged against this mode of formation of aneurism, viz., that aneurisms do not form on arteries suddenly obstructed by ligature, is an unsound one, since they do so form, although rarely.[2] In most of these cases of aneurism produced by embolism the artery is previously diseased.

[In the Transactions of the London Pathological Society, 1877, vol. xxviii., p. 98, are recorded two cases observed by Mr. Bryant, in which aneurism was thought to have been caused by an embolus originating in an ulcerative endocarditis; one was at the bifurcation of the common femoral in a man of 29; the other at the bifurcation of the popliteal in a man of 33. In the same volume, page 106, Dr. James F. Goodhart reports four cases of a similar kind. In three of them the aneurism occupied the middle cerebral artery or one of its branches, in the other the posterior cerebral artery. In one case there was also an aneurism of the ulnar artery, involving the origin of the anterior interosseous. In three of the cases embolic infarcts were found in the spleen.

Dr. Goodhart attributes the formation of an aneurism under these circumstances to alterations produced in the wall of the vessel by the embolus itself, which, in cases of ulcerative endocarditis, is thought to have a virulent or septic character. In like manner the rare dilatation of the ligated end of an artery would be explained, not by the sudden arrest of the stream of blood (for there is no stream through this part of an artery to be arrested, and the pressure is no greater at its end than at the points above it), but by a weakening of the wall, due to extension of the inflammation set up by the ligature.]

To these various exciting causes some have added pressure upon the artery, and consequent obstruction of the circulation, by tendinous or ligamentous bands crossing it below, or by the action of muscles; instancing the pressure of the fibrous arch from which the soleus arises as a cause of popliteal aneurism.[1]

[1] See also a case reported by the writer in the Path. Soc. Trans., vol. xii., p. 61.

[2] See Wounds of the Vessels, vol. i., p. 465.

[1] Verneuil, Bulletin de la Société anatomique, 1835, p. 268.

Such are the causes, predisposing and exciting, of spontaneous aneurism. The term "traumatic aneurism" is usually intended to include only those instances in which aneurism follows a wound known to have been inflicted upon an artery; and this wound is, of course, in the great majority of cases, an open one. In such a case, the wound in the skin usually unites under pressure; the issuing current of blood prevents the lips of the orifice in the vessel from coming together, while the reaction of the neighboring parts, the pressure of muscles and fasciæ, and the supervention of syncope from loss of blood, prevent the unlimited infiltration of blood into the cellular tissue, and the death of the patient from that cause. The blood, being thus hemmed in, quickly loses its more fluid part by absorption, and becomes a more or less solid body, and is encysted in the same way as other foreign substances. In other cases no skin-wound exists; of which the most common instance is the wound of a vessel by a fractured bone, and here the process of formation of the aneurism is the same. The form of aneurism is, therefore, the consecutive; and, *vice versâ*, most consecutive aneurisms are traumatic. Many are, however, spontaneous, being caused either by ulceration perforating an artery, as alleged in Liston's case, or (which is very common) from the rupture of a previously existing aneurism. It has been above noticed that many, if not most, of the aneurisms which surgeons have to treat are, in one sense, traumatic, as having been probably caused by injury; the term is, however, usually restricted to those cases in which the vessel is known to have been penetrated, and will be so used in the sequel.

Progress of aneurism.—When once formed, the tumor is likely to go on increasing as long as the conditions subsist in which it originated. These conditions vary so much, according to the state of the sac, of the parts around it, and of the blood which it contains, that it is impossible to form a clear idea of the disease without studying each of these separately.

The changes in the sac depend in a great measure upon the position and size of its communication with the artery, and somewhat upon the direction in which the sac grows and the part of the artery in which the opening is seated: thus, sometimes the opening is situated on the concavity of the curve of a vessel, so that the artery is stretched over the tumor; more frequently on the convexity or bend of the artery; sometimes the arrangement of the neighboring parts is such that the tumor can only grow in the opposite direction to the current of blood, or that pouches are formed in it. It would carry us beyond our limits to refer to instances of such arrangements, and to point out the variations in growth and progress to which they seem to have given rise. In a fusiform aneurism, in which the orifices of exit and entrance are free, the lateral pressure upon the sac cannot be severe. Hence these aneurisms advance slowly, and do not readily burst. On the other hand, pedunculated aneurisms, in which the sac communicates by a narrow channel with the arterial stream, are seldom found of large size, having usually burst before they attain anything like the size sometimes reached by the aneurismal dilatation.[1] The reason of this fact, no doubt, is, that the impact of the stream of blood through the narrow orifice (supposing that orifice unobstructed) is concentrated more upon one point, instead of being diffused over the whole wall of the sac, as in the previous variety. Between these two extremes there are, of course, all possible shades of difference; but in every aneurism, properly so called, as distinguished from a mere dilatation, the pressure on the wall of the sac is much greater than the natural pressure of the heart.

This may be illustrated by a reference to the scientific toy known as the hydrostatic paradox,[2] in which a small pipe communicates with a closed bellows, the pipe and bellows being filled with fluid. The smaller the opening in the bellows, the greater is the pressure on its walls. An aneurism standing out like a bud from the artery, and communicating with it by a small opening, would bear a resemblance to this machine, though not a strictly accurate one, since regurgitation would go on in the aneurism, which is not the case in the bellows.

[This statement of the principle of the hydrostatic paradox is incomplete, and therefore misleading; and, as it is used in what I conceive to be an erroneous manner several times in the course of this essay, it requires explanation. If an inclosed body of liquid communicates with a column of the same, the pressure upon all parts of its surface will be the same, and will vary with the height of the column, not with the size of the opening. If the area of the opening is one square inch and the pressure of the column upon it ten pounds, a pressure of ten pounds will be exerted upon every square inch of the surface of the inclosure; if the area of the opening be reduced one-half, other conditions remaining the same, the pressure upon it and upon every half of a square inch of the surface will be only five pounds, and the total pressure

[1] Rokitansky, Path. Anat., Syd. Soc., vol. iv., p. 280.

[2] Or hydrostatic bellows. The machine will be found described in most treatises on hydrostatics; *e. g.*, that in the Encyc. Brit., 8th ed., vol. xii., p. 81.

upon a square inch will be exactly the same as before, ten pounds. Furthermore, it is not the aggregate pressure which is here to be considered, but only the pressure upon areas of the same size.

When the inclosure is distensible, as in the case of a pulsating aneurism, the conditions are altered by the fact that, if the orifice of communication is small, an appreciable period of time is required for the passage of enough blood through it to fill the space created by the distension under greater pressure. Before this time has elapsed the increase of intra-arterial pressure accompanying the systolic contraction of the heart has been in part lost during its diastole, and thus the pressure within the aneurism fails to reach the maximum attained within the artery at each pulsation. Consequently, when the orifice of communication is large and free, the pressure within an aneurism is sensibly equal to that existing within the artery at the same moment—they increase and diminish together; but, when the orifice is small, the pressure within the aneurism varies within a narrower range than that within the artery, and remains near the mean, for as it has not time to rise to the maximum during the systole of the heart, so also it has not time to fall to the minimum during the diastole. In neither case is it ever superior to the maximum in the artery, and the smallness of the opening does not increase it.]

In addition to this it may be remarked, that these small openings are sometimes, perhaps always, formed by the giving way of small portions of the atheromatous wall of the vessel. Such small atheromatous patches are sometimes met with in long tracts of healthy artery, where the wall is thin and weak, and where, therefore, a small and weak sac soon forms, and is liable soon to burst.

It does not necessarily follow, however, because the wall of an aneurism gives way, that the tumor therefore bursts. The process is usually a gradual one; and as the old wall is thinned and absorbed, inflammation proceeds in the tissues surrounding the sac, and, by condensing them, supplies the tumor with a new envelope. On minute examination of most large aneurisms, it will become evident that portions of their sac are formed by cellular membrane, muscles, and other tissues, which have originally been distinct from the tumor. In other cases, and especially when the tumor has perforated a bone, its sudden increase marks the occurrence of a large rent in its walls, and the supervention of a large consecutive aneurism upon the original disease.

Another very important element in the condition of the sac of an aneurism, is the nature of the parts by which it is surrounded; since, when the tumor meets with the resistance of bone or other dense tissue, the sac is absorbed or worn away; whilst, when it presses upon organs which are very sensitive, or whose function is important, reaction and inflammation are soon excited by the pressure of the increasing tumor; and in such cases, if the inflammation does not pass a certain limit, perhaps consolidation may ensue, otherwise ulceration will take place. A singular complication of aneurism is where the tumor projects into the cavity of a neighboring vessel, usually the pulmonary artery, or one of the cavities of the heart. Here ulceration seems to take place early, unless the pressure of the sac produces death. When veins lie contiguous to an aneurism, they are usually closed by the pressure of the tumor. Cases, however, are on record in which an aneurism has burst into the cavity of a vein. This circumstance will be again referred to in the section on arterio-venous aneurism.

The changes which take place in the neighboring parts are due either to the pressure of the tumor or to the inflammation which it excites. The growth of an aneurism is often so rapid, that the effects of its pressure are very striking. Veins are closed, nerves expanded and thinned, muscles stretched and wasted, bones roughened or perforated, and even the skin itself sometimes so atrophied as to give way. When aneurism produces irritation in the surrounding parts, the latter may slough or suppurate.[1] The sac is also usually involved in the action, and then the aneurism is opened by the separation of slough, or bursting of the abscess. This is usually accompanied by fatal hemorrhage; but it may lead to the spontaneous cure of the disease, as will be pointed out under that head. The great difference often observed in the progress of internal aneurism, according as it presses upon a mucous or a serous surface, has been well shown by Dr. Gairdner.[2] The hemorrhage produced by the ulceration of an aneurism into a mucous cavity, as the pharynx, œsophagus, or intestine, usually proceeds from a minute orifice, and occurs by small quantities at a time, the opening being very liable to obstruction by a clot; while the opening on a serous surface, as the pleura or pericardium, is often, perhaps usually, a large rent, through which rapidly fatal hemorrhage takes place.[3] Surgical aneurisms

[1] Roux, Quarante Années, vol. ii., p. 260, relates a case in which he believes that an abscess formed over an aneurism, and communicated with it. This case, however, must be allowed to be somewhat dubious. Another and much clearer case of an abscess forming over and opening into an aneurism of the aorta may be found in Broca, op. cit., p. 166.

[2] Med.-Chir. Trans., vol. xlii.

[3] Mr. Obré relates a curious case, in which an aneurism ulcerated into the pericardium by three small openings, each of them only

do not very often come into contact with either of these classes of membrane, but the synovial cavities bear a great analogy with the serous, in this as in other respects; accordingly, hemorrhage from the bursting of an aneurism into a joint is generally rapid and profuse. Two cases of great interest will be found in Dr. Gairdner's treatise, in which the spontaneous opening of an aneurism through the skin was followed by healing of the orifice, and in one case possibly by a cure of the disease; and other instances are on record in which aneurisms have been accidentally opened without ill effects—nay, in some with good effect, from relief of the tension. It is more usual for an aneurism to communicate with one of the large mucous cavities of the body, than with any other part. Then the progress of symptoms usually is, that a slight hemorrhage occurs, which both weakens and alarms the patient to some extent. The bleeding then ceases, whether from syncope, from displacement of parts creating obstruction, or from plugging of the opening by displaced clot; but this cessation is temporary; the fissure reopens and enlarges, and the patient dies exhausted after a few recurrences of bleeding. Sometimes the bleeding occurs in such a situation,[1] or in such quantity as to extinguish life in a moment; but these cases are usually under the care of a physician. Surgical aneurisms, when they burst, usually open into the cellular tissue or into a joint. In the latter case bleeding is generally copious, and the cavity becomes so much distended that pulsation is felt in it. The bursting of an aneurism subcutaneously is usually accompanied by great pain, and by rapid and gradually increasing hemorrhage, producing faintness and syncope; but the symptoms and treatment of these accidents will be more fully considered hereafter.

Another termination of a growing aneurism, which is frequently met with in those affecting the extremities, is by gangrene, the result of pressure. This takes the case out of the category of common aneurisms, and it must now be treated like any other tumor producing gangrene. Aneurisms may remain stationary for a long period, though this is extremely rare. Sometimes, after the apparent cure of an aneurism, *i. e.*, after it has ceased to pulsate, and become stationary, it will again commence to grow, and the pulsation will recur; and in a case of this kind, which has furnished a preparation to the museum of St. George's Hospital, increase of size was noticed without any return of the pulsation.[1]

In that case the artery had been tied above the tumor, and the increase of the latter, which was very marked, from the size of a hen's egg to that of the egg of an ostrich, and which continued during twelve months, led to the suspicion that the diagnosis had been mistaken, and the disease not aneurismal, but malignant. However, the tumor became at last stationary and solid, and the cure lasted during the rest of the patient's life, about one year. After death, the accuracy of the original diagnosis was established. In this case the cause of the absence of pulsation was obscure; but pulsation may sometimes be absent merely in consequence of the position of the opening; and in some cases no bruit may be audible, the orifice being at the deep surface of the tumor, and the force of the stream probably broken by clots. Such was the case in a woman under Mr. Vincent's care at St. Bartholomew's Hospital, in whom an aneurism followed the occurrence of a longitudinal rent in the posterior tibial artery, on its anterior face. The sac being formed at the posterior part of the artery, the stream of blood seemed to enter it indirectly. Hence probably the absence of pulsation. Nor was there any bruit. The diagnosis, therefore, was only made, after a long course of treatment, by an exploratory incision, when amputation became immediately necessary. I am indebted to Mr. Moore for the notes.

The changes in the blood contained in the sac are even more important than those in its walls. They refer to the nature and amount of clot formed in it. It is this clot which, by strengthening the wall of the aneurism, enables it to resist the action of the heart, and so opposes further increase, and which, by its constant increase in size and density (fresh clot forming as the old contracts), encroaches upon and finally obliterates the cavity. As this is the only cure of which the disease admits, except by ablation or in the very rare case of spontaneous cure by sloughing, it is to obtain the deposition of an efficient coagulum that all the efforts of surgeons and physicians in the treatment of aneurism are directed.

In examining an aneurism after death, two kinds of blood-clot will be found in it. The one, which lines the sac, and is usually very firmly united to it, is tough, more or less decolorized and laminated,

about large enough to contain two bristles. Death was rapid in this case; but, had a similar ulceration occurred into the pleura, life might have been sustained for a considerable period, or the openings might have closed. (Path. Soc. Trans., vol. iii., p. 307.)

[1] See, in the Path. Soc. Trans., vol. x., p. 54, two cases in which aneurisms of the abdominal aorta burst, and the blood was effused around, and constricted, the œsophagus in one case, and the duodenum in the other.

[1] Prescott Hewett, Med.-Chir. Trans., vol. xxix., p. 75.

much resembling layers of different-colored leather. The laminæ, and the difference of color, obviously mark a gradual and successive deposition. This laminated coagulum is now frequently called, after Broca, "active clot."[1] The other kind is the amorphous, and red, something like currant-jelly, and is always found inside the former. This soft clot (otherwise "passive clot") may be a mere post-mortem appearance; but it is no doubt often formed in aneurismal tumors during life. I entertain no doubt that the soft amorphous clot is the first stage in the formation of the laminated fibrinous coagulum; and that it must be so in some cases is proved by the fact that aneurisms are sometimes cured by pressure in a very few hours. Now in those cases, there has been no time for the formation of laminated coagulum. The sac must in the first instance have been filled with soft clot, and it seems in the highest degree probable that the soft clot has often become gradually hard and laminated.[2] The formation of soft clot, however, is not a matter of the same importance as that of laminated coagulum; indeed, a too rapid deposit is perhaps in some cases to be deprecated, as leading to a delusive appearance of cure. It is liable to be either melted or washed away by the circulation, and then the tumor, which seemed to be cured, begins to grow again.

[There are cases now on record which show that a cure can be, and perhaps often is, effected by the soft "passive" clot alone, without the deposition of laminated fibrin. This has been observed in two cases after cure of a popliteal aneurism by compression with Esmarch's bandage. The clot forms suddenly within the sac, filling it completely, and extending a variable distance into the artery. It then passes through the changes observed in clots formed outside the body; that is, it retracts and separates into two portions, serum and a compact clot of blood corpuscles and fibrin. The serum is absorbed by the surrounding tissues, and the sac, relieved from the intra-arterial blood-pressure by the plugging of its orifice or of the vessel, shrinks as its contents are diminished by this absorption; its wall thickens both by this shrinking and by the multiplication of its cellular elements. The intima of the artery at the points adjoining the orifice of the sac, irritated by the contact of the clot, or involved in the extension of the productive process carried on in the wall of the sac, forms new tissue which perforates the clot within the vessel from all sides, as it does an ordinary thrombus, and makes the occlusion permanent. The cavity of the sac is thus entirely shut off, and the original clot, much diminished in size, remains isolated within it and disappears slowly by absorption.

Fig. 313.

Laminated (passive) clot.

That this may occur has been demonstrated by the examination of cured aneurisms after death, and it is difficult to explain in any other manner the clinical facts observed in so many cases, the almost total disappearance of the aneurism and the absence of pulsation from the moment the ligature has been applied. The contraction of laminated fibrin, of which Mr. Holmes speaks, has not been demonstrated, and the only reason for supposing it to occur has been the shrinking of a cured aneurism. Each has been used to explain or to prove the other. There is also nothing in the behavior of a clot outside the body to justify the belief that it forms a stage in the deposit of laminated fibrin. Mr. Holmes's argument that it must do so because "aneurisms are sometimes cured by pressure in a very few hours" when "there has been no time for the [preliminary] formation of laminated coagulum," takes too much for granted, and ceases to have any value as soon as it is shown that a cure can be brought about in another manner.

The permanency of the cure depends upon the early plugging by the clot of the orifice of the sac, or, more probably, of the artery, which gives time for the permanent occlusion of the latter, and for the retrogressive changes in the clot and sac; and the explanation of the return of pulsation and disappearance of the clot observed in not a few cases after apparent cure by rapid pressure, must be sought in the absence of such plugging, and in the consequent subjection of the clot to the disintegrating action of the re-established current.

[1] The name does not seem a very well-chosen one, since it is rather the process than the clot which deserves to be called active. Looking at such a clot, which has remained for years unchanged in a cured aneurism, one would be inclined to say that nothing could well be more *passive*.

[2] See Richet, "On Aneurism," Dict. de Méd. et de Chir. prat., vol. ii., pp. 282–295.

In the Transactions of the London Pathological Society, vol. xxix., p. 72, Mr. Wagstaffe describes and figures a popliteal aneurism cured a few months previously by the application of Esmarch's bandage, which is one of the examples above referred to of this method of cure. The sac (fig. 314) was two inches long

Fig. 314.

Popliteal aneurism cured by formation of a "passive" clot.

and one inch in diameter; it contained a central blood-clot measuring one by one-half inch, surrounded by fibrous tissue, which seems to have been the thickened wall of the artery and sac. Bloodvessels could be recognized in it, and the artery was permanently occluded above and below. Another autopsy showing a similar result is reported by Dr. Reid, in the Lancet, 1876, ii., p. 184; and in a third case, also of cure by Esmarch's bandage, the solid clot gave place after a day or two to an area of fluctuation which did not pulsate; and was thought to be the exuded serum of the clot itself. It disappeared as the tumor diminished, and the cure was permanent. Such a phenomenon is inconsistent with the alleged formation of laminated coagulum by the passive clot.]

It will be remembered that the first phenomenon of atheroma consists in the deposition, out of the fluid blood, of a fibrinous stratum on the wall of the artery. The commencement of coagulation in an aneurism bears, at any rate, a strong resemblance to this; but, unlike the formation of atheroma, it seldom, if ever, takes place where the sac is exposed to the full force of the blood. The least diminution of the circulation, however, as from pouches in the sac, from roughness of its walls, or from external causes moderating the impulse of the heart, will lead to the formation of tough fibrinous coagulum on the wall of the aneurism, though what is the exact physical cause of this coagulation is unknown. It seems to require for its commencement a diminution of the circulation, but not its entire stoppage; indeed, it sometimes seems to go on less readily when the stream is stopped altogether. When once tough fibrinous coagulum is formed, it has a tendency to propagate itself through the contiguous layers of blood until the whole sac is full, unless the stream of blood should be too small for it; and when once formed, the clot acquires greater density, partly by the inherent power of contraction possessed by fibrin, partly because it is, as it were, hammered out by the impetus of the circulation. It is interesting to compare different parts of the same sac: here, fibrin accumulates in strata; there, all is worn away—the sac, the surrounding soft parts, the periosteum, even the bone. A careful study of the parts will generally prove this to be owing to the impact of the stream of blood, and to the resistance of the surrounding parts; the attrition to which the sac is thus subjected easily explains its absorption. In this process of absorption, it seems that the clot may also be involved; that is to say, that even laminated coagulum may, in some conditions of the sac, be removed—an effect which can hardly be attributed to anything but the action of the vessels of the sac upon it. But if the vessels of the sac can remove the clot, may they not also deposit it—that is, may not the laminated fibrin which lines the clot be an exudation from its vessels, rather than a kind of precipitate out of its contents? This is the opinion of some pathologists,[1] who consider the process as somewhat analogous to inflammation. But if it were so, the internal layers of clot ought to be the oldest, having been pushed inwards by the increasing deposit; now every-day observation of their color and consistence

[1] Colles "On Aneurismal Sacs," Dublin Quarterly Journal, 1856, vol. xxi., p. 53; Wardrop, article "Aneurism," in Costello's Cyclopædia of Surgery.

proves that they are the most recent. The exact cause, however, of the formation of laminated clot must be allowed to be obscure. It is enough for our present purpose to know that in an aneurism such clots have the greatest possible tendency to form, and will form almost inevitably to some extent when the full force of the circulation has been withdrawn. Even in tumors which are rapidly increasing, it is usual to find coagula in parts where the stream has been less powerful.

The nature of the connection between the sac and its lining of fibrin, is another obscure point in pathology. M. Broca, in an interesting passage of his valuable work,[1] endeavors to prove that the laminated clot formed in an aneurism possesses a certain grade of vitality, however low. But the facts which he adduces to prove the vascularization of such coagula do not appear strictly applicable to aneurismal clots. John Hunter and Blandin have injected clots in arteries after ligature, and Kiernan in a concretion forming in a vein below a tumor; but in both these cases there are evident sources of vascular formation, which do not exist in a cured aneurism; nor have I succeeded in meeting with any unequivocal proof that vessels pass between the sac and its lining of coagulum, nor with any facts which prove that such clots ever share in the vital actions, inflammatory or otherwise, of the parts around them, except the partial absorption mentioned above, which very likely is an absorption merely of the watery parts of the clot; so that the cure by laminated fibrin, when once complete, may be expected also to be permanent. There are cases where, after apparent cure, the aneurism has reappeared sooner or later, and sometimes after many months of apparent inaction. In such cases it is probable that either the clot was not complete, but allowed circulation to go on through its cavity, or that a portion of it was of the soft, not the laminated, variety.

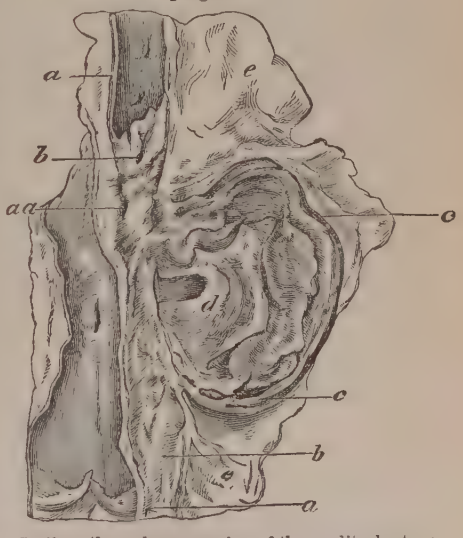
As to the statistics of aneurism as it affects the different arteries in the body, I do not believe we are in a position to make any statements worthy of credit. In Dr. Crisp's work may be found an elaborate table of all the cases published up to that date; and Dr. Sibson has since given still more extensive researches as to aneurism of the aorta. Such tables are of great interest and utility in some other respects, principally in reference to the usual course and termination of each class of cases. But they are useless for the purpose of showing the liability of individual arteries to disease, since they always include an unnatural proportion of "interesting" cases. Thus, in Dr. Crisp's table of 551 cases, the popliteal aneurisms (137) are nearly as numerous as those of the thoracic aorta (175); and adding femoral (66) to the former, the proportion of surgical aneurisms in the lower extremity would be greater than of thoracic—an absurd conclusion. The only way to determine the relative frequency, with any approach to correctness, would be to take the unpublished and miscellaneous records of our large institutions, such as our hospital registers; and even this would not be absolutely correct, since, after all, it would only give the proportion among the working classes. The point is perhaps hardly worth the trouble necessary to decide it.

[1] Op. cit., pp. 127 et seq.

Spontaneous Cure of Aneurism.

Since aneurism is a disease which consists essentially in disturbance of the natural equilibrium between the force of the circulation and the elastic reaction of the arterial walls at the part affected, and since the blood which fills the aneurismal sac shows a strong tendency to coagulate when the full force of the circulation is diminished, it follows that the disease is one peculiarly easy of cure in favorable cases; for the coagula formed by the external layers of blood in contact with the wall of the sac soon acquire an organic connection with it, and thus strengthen it, and, if uniformly deposited, enable it to resist the impulse of the blood over its whole circumference, and thus to check

[Fig. 315.



Sections through an aneurism of the popliteal artery cured nearly two years before by digital pressure.]

the further progress of the disease. When this has been once effected, *i. e.*, when the whole wall of the sac has once recovered its power of resisting the distending force

of the circulation, coagulation will generally advance from without inwards until the whole sac is filled with solid fibrin. The process may of course be interrupted by anything which temporarily augments the force of the circulation, such as intemperance, disease, exertion, or perhaps even great mental agitation; or it may be retarded or suspended by internal causes which modify the coagulability of the blood.

Several conditions or modes of spontaneous cure have been pointed out by pathologists. 1. The most simple, and as it seems the most common, is the coagulation of the blood in the sac in consequence of mere retardation of the circulation. 2. Another cause of coagulation in the sac, much insisted on by writers, but rarely if ever seen in nature, is the pressure of the aneurismal tumor upon the artery in the neighborhood of the sac, whereby the entrance of blood into the aneurism is hindered. 3. Another method, which has often been proved by dissection, is the stoppage of circulation through the tumor by a piece of clot which has been washed into the mouth of the vessel as it leaves the aneurism, or even at some distance from the latter. This plugs the opening incompletely at first (at least in most cases), but increases gradually by a deposition of fresh fibrin, till the orifice is quite closed. The circulation is then diverted into the collateral arteries. 4. In some much rarer cases, a clot may be carried down into the artery above the tumor from an aneurism higher up, or the retardation caused by the latter may cause coagulation in the lower sac. 5. Another method of spontaneous cure is by suppuration and sloughing of the tumor; and it is believed that aneurisms may be cured by inflammation of the sac without suppuration.

The fact that few aneurisms are found without some formation of laminated clot upon, at any rate, a part of their circumference, shows how strong is the tendency to cure. Wherever the wall of the tumor is sufficiently strong, clot will form upon it during any temporary diminution of the force of the circulation; and this clot will encroach upon the cavity, and may form the nucleus for a complete cure. Unfortunately it usually happens, and especially in aneurisms situated near the heart, that this effort is only transient. Either the circulation, recurring with greater force, overcomes altogether the barrier set up against it, and reproduces the uniform expansion of the sac, or the sac has some weak point where the clot does not form, or the circulation in the centre of the tumor is too powerful for coagulation to go on there. The form of the tumor, and the nature and size of its orifice of communication with the artery, must of necessity exercise great influence on the probability of this event. Thus a tumor formed by a mere expansion of the artery (fusiform dilatation) will have a much more powerful stream passing through it than one which stands out from the vessel like a bud, and is attached to it by a kind of neck.[1] Tumors of the latter form are, it is true, comparatively rare; but the intermediate form, in which the dilatation is confined to only a part, and that not a very large part, of the circumference of the artery, are the most common—at least among surgical aneurisms—and are much more prone to spontaneous cure than the fusiform aneurism. Then the state of the mouth of the sac will exercise an effect on the stream. If the orifice be smooth, and the internal coat prolonged into the sac and free from deposit, the blood finds no obstacle to its passage; but in contrary conditions, with a rough orifice and coagula projecting into the artery, the force of the blood must be much broken. Some pathologists believe, with Cruveilhier, that the clot is never deposited on the smooth wall of an aneurism formed by the healthy arterial coats simply distended; hence that tubular aneurisms never contain coagula. It is very difficult to be sure of this. The figure on p. 315 shows that laminated coagula are at any rate sometimes found in sacs of this sort, and it is scarcely possible to discover what was the condition of the lining membrane at the point where the coagula were deposited.

The statement that aneurism is a mechanical lesion, and that its cure is to be sought by mechanical means chiefly, is not meant to exclude from consideration the advantage that may be derived from an increase in the relative quantity and coagulability of the fibrin of the blood. It is true that the attempts which have been made to induce coagulation directly by chemical means have as yet partially failed; but methods, such as bleeding and starvation, which increase the relative quantity of fibrin,[2] and diminish the force of the circulation, have often succeeded by themselves, and, when not pushed beyond what is prudent, form an important adjunct to some other plans of treatment.

The reader may now be asked to consider briefly each of the conditions or

[1] But though the stream is more powerful, its lateral expansion, *i.e.*, the pressure on the wall of the sac, is much less so. Hence the fusiform dilatation rarely attains the size of the saccular aneurism, and is not prone to bursting.

[2] On the influence of bleeding and starvation on the amount of fibrin, see Todd and Bowman, Phys., vol. ii., pp. 311, 312.

proximate causes of spontaneous cure spoken of above. The first is the mere retardation of the circulation. This may take place under conditions which it is impossible to foresee and therefore to produce; but the chief and happily always accessible requisite is *rest*, which has been frequently known to effect the cure of aneurism, whether external or internal, with little assistance from any other means.

Such an instance is the following: A man was admitted into hospital, under the care of Mr. Luke, on account of a tubular aneurism of the femoral artery, unaccompanied by bruit or affection of the pulse in the lower part of the limb. The tumor was of a year's standing; it was compressible, and could be emptied of its contents. A plaster and bandage were applied, but apparently not so firmly as to produce much pressure, and he was put to bed. A good deal of pain was felt under the plaster for half an hour. It was left on for five days, and at the end of that time the tumor was found solid, and pulsation had ceased in it and in all the arteries of the limb. At the last recorded examination of the patient, two months afterwards, the pulse in the limb had not reappeared.[1]

[Another noteworthy case is the following, taken from the Lancet, October 9, 1880, p. 600.

On December 30, 1878, Mrs. ——, aged 69, of middle height, a rather stout and strong woman, went to see a neighbor's pig killed, and, when standing by, an old man tumbled up against and over her, knocking her down forwards on her face and knees. She felt something give way in her right knee, and from this time had great pain shooting down her leg "like a bad gathering." I saw her a week after, and, from her description of the pain and accident, I suspected aneurism, and on examination found a pulsating swelling at the lower part of the popliteal space, with all the characteristics of aneurism, but the bruit not well marked. The muscles of the leg (outside particularly) were also a good deal strained. I ordered lead lotion and complete rest; bnt she would not even keep her leg up, and I could not make her understand that the case was a serious one. Four weeks after this, as the aneurism was getting larger and the pain severe, I persuaded her to flex the knee as much as possible at night when in bed, and keep the leg up in the day-time. In a week the pulsation was perceptibly less, the pain very much less, and the tumor smaller. At the end of three weeks the pain was almost gone, and the aneurism hardly to be felt at all—in fact, had almost disappeared. At this time she took liberties, walking about, etc., and the tumor became larger and more painful, but felt hard, as if a good deal of deposit had taken place. I cautioned her that she might have to undergo a serious operation, besides suffering great pain, if not more careful, after which she behaved better, and the tumor gradually subsided, there being no sign of it on May 10, 1879. The only treatment carried out (and that only partially) in this case was flexing the knee at night when in bed. The cure was complete, and the woman has been well ever since.]

A great number of such cases might be cited from the various authors who have treated this subject. Hence the first advice given by a medical man to a patient in whom he discovers the existence of aneurism is to keep quiet. It is a pity that this recommendation is not made more stringent. The patient, instead of being merely enjoined to lead a quiet life and avoid all causes of excitement, should be rigidly confined to bed and to the recumbent position. But a still more powerful remedy consists in spare diet, though this should never be used except as an auxiliary to rest.

The following case deserves notice as illustrating the possibility of cure even in a condition usually regarded as quite hopeless.[1] A publican consulted Mr. Stanley in October, 1847, for a large pulsating tumor in the right breast, which *was rapidly increasing*. The symptoms do not concern us here; it was diagnosed to be aneurism; and he was advised to go home and keep himself perfectly quiet. Accordingly he went home. lay in bed for six months, and fed only on beef-tea, milk, and light pudding. At first the tumor seemed to grow; but from Christmas of that year its walls gradually got harder, the pulsations diminished in force, and by March, 1848, were no longer perceptible externally. He then left his bed, having become by this time very pale, emaciated, and feeble. He lived very abstemiously for four years and a half, when a general election "excited him to deviate from the tranquil and abstemious habits he had practised." He died of acute pleurisy after exposure. A large sac was found communicating with the aorta by an opening (1 in. by 1½ in.) just below the innominate artery in the posterior wall of the vessel. There was only a cavity large enough to contain a horse-chestnut, the rest was all filled with firm coagulum. The tumor had been of enormous size (7½ in. from side to side and 4 in. vertically). The disease which proved fatal appears to have been quite unconnected with the aneurism.

Bleeding is also a powerful agent in this plan of treatment. It is a remedy now little used, in consequence of its abuse in the time of our fathers; but it may be permitted to us to doubt whether the reaction has not been carried somewhat too far. Doubtless the repeated and copious

[1] Luke, in Lond. Med. Gaz., May, 1845. For other cases see Bellingham, On Aneurism, p. 148.

[1] Path. Soc. Trans., vol. v., p. 107.

venesections of old times could hardly be otherwise than injurious. Valsalva, it is said, used to bleed his patients day after day till they were unable to stand, and could hardly raise their arms from the bed.[1] This is an excess to which our modern habits as well as the prejudices of our patients, would effectually prevent surgeons of the present day from resorting; and there can be no question of the danger and impropriety of bleeding, when so insisted upon.[2] But the moderate use of venesection appears both rational and, as far as we can judge from recorded cases, successful. Bleeding seems to increase the relative amount of fibrin in the blood; nor does it appear, when moderately used, to lessen its coagulability; while its effect on the power of the heart and the rate of the circulation may be calculated with some approach to certainty. That this effect is transient is very true, but so is the action of all the cures for aneurism. A transient effect on the circulation is all that is needed for the formation of laminated clot, which will then, in favorable circumstances, go on to extend it. Besides, bleeding has the recommendation that it can be repeated, and its quantity proportioned exactly to the condition of the circulation. The great objection to its use appears to be, that (in internal aneurisms especially, but in all aneurisms to some extent) the antagonism between the heart's action and the forces acting in the tumor has a tendency to cause stoppage in the heart, and death from syncope.[1] This is especially likely to happen in the fluttering action which succeeds copious venesection, and it is on this account mainly that bleeding is dangerous. Still, there are too many records by different, and those the most competent, observers, to allow of doubt as to its great utility, in some cases, although probably in this, as in so many other things, the acute judgment of Sir T. Watson has hit the mark when he says that venesection is only admissible so far as to reduce *excessive* arterial action. For this purpose it is certainly a more manageable and more certain agent than digitalis. Dr. Stokes has suggested a modification of Valsalva's treatment, in which the small and repeated bleedings which Valsalva prescribed are retained; but the diet is opposite to Valsalva's. "It should," says Mr. Porter, to whom we owe our knowledge of this suggestion, "be light and very nutritive, but of course free from any material of a stimulating nature." (Op. cit., p. 81.) It does not appear that any marked success has attended this plan.

The medical means available for the cure of aneurism, beyond those just enumerated, are very few. Certain drugs which retard the circulation have been used for this purpose; but without much success. Digitalis is both dangerous and uncertain. The action of tartar emetic, or of copious watery purges, seems only to be to produce weakness, which can be done with less distress by the means above enumerated. Some of the alkaloids exert a remarkable influence on the heart's action; such are aconite and veratrum.[2] Whether these have ever been used in internal aneurism I am not aware, but it would seem worth while to give them a cautious trial. M. Bouillaud has published a clinical lecture[3] *On the Treatment of Aneurism by the Iodide of Potassium.* Four cases are related, all of which were benefited and one was thought to be cured. I have not myself perceived any benefit from the use of this remedy, though I have occasionally prescribed it for long

[1] Hodgson, op. cit., p. 145. Some writers have thought that the usual representations of Valsalva's practice are exaggerated; but it is clear, from Albertini's account (Acta Acad. Bonon., vol. i.), that its general principle is correctly understood.

[2] M. Broca seems favorable to the application of the method of Valsalva in the treatment of aneurisms of the thoracic and abdominal aorta, and of the subclavian artery. I do not observe, however, that he has given any instances of the application, successful or otherwise, of this method, except one, the reference to which I have been unable to verify; nor have I met with any instance of the application of Valsalva's method, properly so called, in modern practice. In a case brought before the Pathological Society, by Dr. Broadbent (Path. Soc. Trans., xiii., 44), dyspnœa, the result of an aneurism of the aorta, had been much relieved by bleedings practised at rare intervals; but this is, of course, quite a different thing from Valsalva's treatment. Porter speaks of having bled to syncope, several times, a patient with aortic aneurism, and always with marked relief; op. cit., p. 82. In Mr. Hodgson's work numerous cases will be found quoted where a practice more or less closely resembling that which goes by the name of Valsalva was followed with success.

[1] "An apprehension has been entertained by some, that a patient suddenly reduced to a state of syncope might never rally, and actually die of, or be killed by, the operation; and perhaps such a casualty may have occurred."—Porter, On Aneurism, p. 83.

[2] On the action of veratrum, see Lancet, vol. i., 1862, p. 21.

[3] See Brit. and For. Med.-Chir. Rev., Jan. 1860. Another successful case is referred to in the Am. Journ. of the Med. Soc., Oct. 1865, under the care of Dr. Sewall, of Canada. Here, however, starvation and absolute rest in bed were also employed.

periods of time, gradually increasing the quantity to enormous doses. The acetate of lead has been recommended by Dr. O. Rees[1] on the authority of a case of popliteal aneurism in which no other treatment was employed, and the tumor gradually consolidated as the patient was brought under the constitutional influence of the drug. My own experience of this plan also is, I regret to say, negative; but I regard it as the most hopeful of the medical means available for the treatment of aneurism.[2]

It is possible that an aneurism, though beyond operative interference, may still be accessible to local applications (*e. g.*, at the root of the neck, or in the chest); in such a case, ice may be applied to the tumor. Some surgeons use refrigeration, as an accessory to pressure, in the case of external aneurism. The method is one of doubtful efficacy. I have seen it tried occasionally, but without any effect. It should not be forgotten, that gangrene of the skin has been so produced.[3]

It seems to follow from the above facts that when aneurism is beyond operative interference, the best thing that can be done is to keep the patient quiet in bed for months, and years if need be, avoiding all causes of excitement, mental and bodily; to administer a light, unstimulating diet, but without denying him sufficient nutriment; to keep the part in such a position as may rather impede the supply and favor the return of blood; to use venesection in small quantities, and carefully, when the circulation appears at all above the normal standard, which, it should be remembered, ought to be below that of health; and, finally, to surround him with an equable cool temperature.

A cautious trial may be made of the acetate of lead, of the iodide of potassium, or of any of the drugs which act more immediately on the circulation; but I do not think that there is sufficient prospect of benefit from their employment to render it justifiable to insist upon their use to the prejudice of the general health. Some very gratifying cures have been wrought by such-like medical means; and although, perhaps, the cases will not be many, yet some lives will be spared by the judicious use of such means, which would be sacrificed were the opinion acted upon that the disease is a necessarily fatal one, for which art can do nothing.

The second method of spontaneous cure, above indicated (p. 328), is that in which the artery is presumed to be obliterated above the sac by the direct compression which is exercised upon it by the aneurism. It is thought that a tumor, arising by a narrow neck from the artery, may fall back, as it were, upon the latter and close the vessel. This conclusion is drawn from dissection of cases principally of popliteal aneurisms, which have advanced to a large size, and have then become obliterated by clot. It may be remarked that, from the very nature of the case, such dissections must always be subject to much doubt; inasmuch as, at the period of the dissection, coagulation has advanced to such an extent that it is hardly possible to tell where it began; and that appearances nearly, if not quite, identical are found in tumors where it is clear that no such pressure could have been exercised; and further, that the explanation arose from those false views of the pathology of arteries which led surgeons, some years ago, to regard inflammation of their internal coat as a common result of pressure,[1] and obliteration of the artery thereby, as a common, if not a necessary condition of the cure of an aneurism by pressure.[2] So it was thought that the pressure of a large tumor would so irritate the artery as to make it inflame and become filled with clot, and that thus the aneurism would be cured. We know at the present day, after so many limbs have been dissected in which pressure has been used, whether successfully or not, that an artery will bear, without the least visible alteration of its calibre, an amount of pressure many times greater than could be exercised by any tumor (see fig. 322). We know also the ease with which arteries elude the gradually-increasing pressure of tumors; nor are dissections wanting in which arteries placed in the condi-

[1] Lancet, 1865, vol. i., p. 280. Another successful case is related by Dr. Daly in the Lond. Hosp. Reports, iii., 179, where, however, absolute rest and local cold were also used.

[2] Dr. F. Flint reported (Practitioner, London, 1879, vol. xxiii., p. 31) a case of aneurism of the abdominal aorta which was apparently cured by the use of the chloride of barium in doses of from $\frac{1}{5}$th to $\frac{2}{3}$ths of a grain, three times daily, for about five months, after Tufnell's method had entirely failed. The most rapid improvement coincided with the smaller dose.]

[3] Broca, op. cit., p. 249 et seq.

[1] See Freer, On Aneurism, p. 112; Hodgson, op. cit., p. 106.

[2] Most of the recorded cases are clearly instances of obliteration of arteries by impacted clot, as in the case quoted by Hodgson (op. cit., p. 110) from Astley Cooper, where the carotid artery was found obliterated in a case of aneurism of the aorta. This could hardly have been the result of pressure, since the effects of such pressure must have been more marked upon the trachea, pneumogastric nerve, or jugular vein than the artery, but is no more than what often occurs from impaction.

tions supposed are found to be completely pervious.

Such a preparation exists in St. George's Hospital Museum. It exhibits an enormous popliteal aneurism, which seems to have undergone a process of spontaneous cure. Its size, however, was so great that the pressure produced on the veins occasioned gangrene. The man was admitted on this account; the large solid tumor in the ham was thought to be malignant, and the limb was amputated.[1] The case occurred many years ago. No further history is preserved. The artery, which has been raised by the tumor and stretched over it for several inches, is nevertheless quite pervious. It communicates with the aneurism by only a very small mouth; and though the limb has been injected, hardly any of the injection has passed into the sac, so firmly is the mouth of the tumor sealed by clot. In this case, if ever, it might be expected that the artery would be obliterated, since the tumor, being of immense size, must have exercised great pressure, and the blood showed a strong disposition to coagulate.

It may be, however, that this method of cure is only possible when the artery is caught between the tumor and the bone, as might happen when popliteal aneurism is developed on the posterior face of the artery; but it is hardly conceivable that the tumor should ever exercise very vigorous pressure towards the bone in such a case, since it meets with so much less resistance in the other direction. For these reasons, the existence of this method of cure seems doubtful. It is, at any rate, a matter of little practical importance (though no doubt of much pathological interest), since no one would dream of encouraging the growth of a popliteal, or other accessible aneurism, on the speculation of its ultimately curing itself by pressure on its own artery.

A more clearly proved mode of cure is that which is produced by the impaction, in the distal portion of the vessel, of a portion of clot from the aneurism. The occurrence of this circumstance in the arterial system in cases of fibrinous concretions on the valves of the heart, as pointed out by Dr. Kirkes, has now been universally admitted, and is a frequent cause of gangrene, of softening of the brain, etc. (see p. 309). It seems also to be a not infrequent cause of the obliteration of arteries below an aneurismal tumor, followed in some cases by gangrene of the limb (or by death if situated near the heart), in others by the spontaneous cure of the aneurism. The way in which this latter result is produced appears to be as follows: If a branch comes off from the artery between the aneurism and the part at which the clot is impacted, this branch may enlarge until it replaces the original artery, and the whole process may remain without result. But if no such branch comes off (as is the case in the great majority of instances, since the impaction usually occurs just as the artery leaves the aneurism), then the whole force of the heart, as far as it acts on the artery affected, is employed in dilating the sac, the artery above it, and the branches of the latter. Sometimes the sac yields to the force, and the aneurism bursts, especially under undue muscular exertion.[1] If this does not take place, and the circulation through the limb is still to go on, the branch or branches above the aneurism, and their communications or anastomoses with the artery below it, must enlarge. When this is effected to a sufficient extent, the full force of the circulation is withdrawn from the aneurism, which will then usually undergo the process of coagulation. It is quite obvious that it matters nothing to this process how far below the aneurism the clot may be impacted, provided that no considerable branch comes off in the interval, since the intermediate portion of artery exercises no influence on the circulation, and may, for the purpose of this argument, be regarded as part of the aneurismal sac. This process of spontaneous cure is imitated in the methods which bear the names of Brasdor and Fergusson.

This plugging process may go on gradually as well as suddenly, as is proved by its being found occasionally complete in persons who have never presented the serious symptoms known to accompany the impaction of a clot in a large artery; and still more clearly by its being met with in an imperfect condition, the artery being lined with a tube of fibrin, which still leaves a small channel for the blood.[2] It seems possible that the existence of another aneurism higher up may sometimes effect the spontaneous cure of the lower one, either in consequence of clot being washed down from the upper aneurism into the lower, or into the artery as it enters or leaves the lower sac, or (as it is said) by the retardation of the current caused by the upper aneurism. It is difficult to be certain as to whether the latter mode of cure ever really occurs, though cases are on record which appear to prove its occasional occurrence. It is, at any rate, possible, since feebleness of pulse in

[1] A similar preparation has recently been placed in the Museum of the Royal College of Surgeons.

[1] Such seems to be the true explanation of a case reported by Mr. Avery, in Path. Soc. Trans., vol. iii., p. 88, as an instance of pressure by the aneurism on the artery above it.

[2] See above, Atheroma, p. 306.

the limb below is a constant symptom of aneurism. In the other case, *i. e.*, when a piece of clot is washed out of an aneurism above, the process exactly resembles that which has just been described.

There remains another process by which aneurisms have been known to become cured; and this consists in the suppuration of the sac and the ejection of the whole tumor by a process of sloughing. In this process, as in other instances of sloughing, the artery, for some distance on either side of the gangrenous part, is closed by coagulum,[1] so that hemorrhage does not take place, as might have been apprehended.[2] Or, in other cases, the sac may slough, and the artery, not being thus sealed, may give way, and the patient survive the hemorrhage thus occasioned; syncope is produced, and coagulation occurs during this syncope, sealing the mouth of the artery. This, at least, is Dr. Crisp's opinion, but it is doubted by Broca; nor do I find references in Dr. Crisp's work to the cases upon which such an opinion is founded. Inflammation without suppuration, in the neighborhood of the sac, is also spoken of by Broca and others[3] as an occasional cause of spontaneous cure. I have not been able to find any cases which are, to my mind, quite satisfactory. Some, as the case reported by Mr. Sidey,[4] appear to have been cures by impaction of clot.

The surgical treatment of aneurism, as far as it is successful and rational, is merely an artificial imitation of these processes. The treatment by gradual and partial compression of the artery, above the tumor, has no other aim than to imitate nature in the first of the processes described above, so as to slacken the circulation through the aneurism, and allow the blood in it an opportunity of coagulation. The Hunterian operation has essentially the same object, although it accomplishes it in a different way, and by obliterating a portion of the artery above the tumor puts a more decided, but at the same time more temporary, check on the current of blood. The treatment by sudden or total compression also aims at suspending the circulation through the sac completely for a short period. The cure by flexion (Mr. Hart's method) aims at combining this first process with the second, in which the aneurism is compressed by the parts around it, and itself (perhaps) compresses the vessel. Sir W. Fergusson's plan of manipulation, or crushing, is derived from observation of cases in which the natural cure was effected, or attempted, by the impaction of a clot in the artery leaving the sac. Brasdor's method, so far as it is justifiable at all in practice, *i. e.*, with the modifications hereafter to be described, is identical with this in its object, and rests upon the same pathological basis. Direct pressure appears to cure aneurism usually by displacing portions of the clot, and may perhaps sometimes act by setting up inflammation in the sac or parts around it, which leads to coagulation. Finally, the old method, by opening the sac and tying both ends of the artery, bears the strongest analogy to the cure by suppuration, and is, in fact, a kind of excision of the tumor.

The methods of spontaneous cure have been dwelt upon at this length with the view of impressing upon the mind of the reader that all successful plans of treatment are successful from being imitations (whether designed or fortuitous) of these natural processes, in the hope that this fact may lead practitioners to a more careful study of the workings of nature in this particular, and the conditions under which she works. Such a study, carried on by various observers, could hardly fail to be fruitful in results which would lead to the preservation of numerous lives that would be sacrificed to the idea that internal aneurism is a disease almost necessarily fatal. What else was it than the careful study of the natural process of cure that led Hunter to his brilliant and daring proposal of tying the artery away from the seat of the disease? What else led the Irish surgeons to see that compression, in order to imitate nature, need not suspend the circulation entirely, need not even act continuously; and thus to substitute, for the intolerable torture inflicted by the old plan of compressing, a treatment which in ordinary cases is harmless, and in a few absolutely painless? Let us remember how comparatively short a period it is since one of the most celebrated surgeons of his time[1] announced his preference for amputation over all other methods of treating popliteal aneurism. Let us not forget that one of our most justly valued authors on this subject[2] was so satisfied with the advance which had been made at the time he was then writing, as to express his opinion that "the improvements that had been effected in the mode of applying the ligature to arteries have brought the surgical treatment of aneurism to a degree of perfection which leaves but little room for advancement." Nor was such an appre-

[1] See Mortification, vol. i., p. 354.

[2] See the cases related by Hodgson, op. cit., pp. 103–5.

[3] Richet, Dict. de Méd. et de Chir. prat., ii., 291.

[4] Edin. Med. Journ., vol. iv., p. 768.

[1] Pott, Chirurg. Works, vol. iii., p. 220.

[2] Hodgson, op. cit., p. 190.

ciation of modern surgery at all exaggerated or unreasonable to those who looked at it as Mr. Hodgson did, by comparison with the mortality after the old operation. In our time, surgery has made such rapid advances, that the mortality, which under the system praised by Mr. Hodgson must have amounted to a large percentage of those operated on,[1] is now very much reduced by the invention of instrumental compression, and even this will no doubt soon be further reduced by the more frequent use of flexion and digital pressure. So it may be in medical practice. At the present day, it is hardly too much to say that a patient with internal aneurism is condemned to death as certainly as one with external aneurism used to be to amputation. A century hence, we may hope, our descendants will have as solid reason to boast of their improvement upon the science of Watson and Latham as we have to congratulate ourselves on our advance upon the doctrines of Pott.

The extent to which the deposit of clot in spontaneously cured aneurisms proceeds, is one of the most curious and beautiful instances of that power of adaptation which the many processes of disease in the body furnish in such abundance to our notice. Generally speaking, the fact of the completion of this deposit implies the entire obliteration of the aneurism and of the artery for some distance on either side of it; and so great are the resources of the collateral circulation, that any part of the arterial tube beyond the first three great branches of the aorta may be, and has been, obliterated without compromising the life of the patient. Thus, numerous cases of obliteration of the thoracic aorta below this point have been recorded; the innominate has often been successfully obliterated by nature, though only once as yet by art, and a case is even on record[2] in which the cœliac artery and all its branches, with the commencement of the superior mesenteric, were involved in the obliteration of an aneurism seated on the abdominal aorta, without any loss of vitality of the viscera, which must (although the fact is not stated) have been nourished from the phrenic arteries on the one hand, and the inferior mesenteric on the other.

But these great channels of vital supply, though in favorable cases they may be stopped in this gradual manner without loss of life, cannot be so without extreme danger. In rare instances, however, we see that the cure of the aneurism proceeds to such an extent as to insure the sac against the force of the circulation, but that a channel is still left by which the blood passes, as it used to do through the healthy artery.

Of this a striking instance is figured in Mr. Hodgson's work[1]—a tubular aneurism of the femoral artery which has been coated throughout with a thick layer of laminated fibrin, while a channel is left in the centre, through which the circulation has been carried on, just as if through the natural artery.

Another case of this species of cure was exhibited by the present writer to the Pathological Society, and may be found described in their Transactions, vol. ix., p. 172. The preparation in St. George's Hospital Museum displays an aneurism of the cœliac axis, of which no complaint was made and no symptoms existed while the patient was under observation during life. It has been so far filled with laminated coagulum that the walls of the sac are everywhere of great thickness, and there is only a small portion in the centre in which the clot was loose and soft, filling it only partially, and no doubt formed after death. The three branches of the cœliac axis spring from the distal extremity of the aneurism, and are in all respects natural. There could be no doubt that circulation had gone on through the central part of the sac, which had thus replaced the original artery.[2]

Symptoms of spontaneous cure.—The symptoms of the occurrence of spontaneous cure in an aneurism appear to vary according as the cure is produced by the gradual deposition of laminated fibrine in the sac or artery, or is the consequence of the sudden occlusion of the

[1] I am aware that in Dr. Crisp's tables the mortality of 110 cases of popliteal aneurism operated on by Hunter's method is given at twelve only, and in seven of the others amputation was necessary, and succeeded. But there is much danger in drawing conclusions from lists formed of published cases, which usually (perhaps it may be said always) include far too large a proportion of successful operations. From the comparatively few cases I have myself witnessed, I should suppose that the mortality is nearly double that which Dr. Crisp's table gives. But such questions can never be settled till our large hospitals can be persuaded to make efficient arrangements for the preservation of complete and unbiased statistics. A very different computation of the mortality will be found further on.

[2] Hodgson, op. cit., p. 125.

[1] Plates to Hodgson, op. cit., pl. vii., fig. 4.

[2] See also Sir Astley Cooper's case, related by Hodgson, op. cit., p. 134, and preparations from two cases in the Hunterian Museum, No. 1641, which is figured on p. 315, and Nos. 1687, 1688. The latter two preparations are a pair; they show aneurisms of the internal carotid on either side nearly filled with laminated clot. The history of the case extends over five years, and is reported by Sir G. Blane. The symptoms were all cerebral: dimness of vision, diplopia, loss of appetite, maniacal excitement, etc. Benefit was always derived from bleeding, antimony, and abstinence.

artery by clot. When it occurs by sloughing of the sac, the progress of the disease is of course entirely different. Usually nothing is remarked, except that the pulsation becomes less violent, the tumor less prominent, and the sac, when emptied by pressure on the vessel above, more solid and resisting. Soon afterwards, in a time varying according to their size and position, the anastomosing branches will be felt enlarging, in most cases of superficial aneurism. When this is the case, the cure is generally not far off. The aneurism will soon be found transformed into a solid tumor of much less than its original bulk.

Sometimes things go on differently; the cure being ushered in by symptoms of great severity, principally disturbance of the functions of parts supplied by the affected vessel, accompanied by more or less pain, sometimes very severe.

Thus in a case of spontaneous cure of aneurism of the innominate artery, reported by Dr. J. W. Ogle,[1] the cure was ushered in by urgent head-symptoms, and complete unconsciousness. The carotid artery was found after death to have been obliterated; and, no doubt, the head symptoms coincided with and were caused by the impaction of a clot in the vessel supplying the brain. In a case of aneurism of the right carotid, involving, perhaps, also the root of the innominate, treated by Wardrop's method, and reported in his work On Aneurism, p. 98, may be seen the account of a similar seizure. "The patient was taken suddenly worse, and appeared to be dying; his countenance ghastly, and covered with perspiration; tracheal rattle, and inability to swallow." Other severe symptoms were also present. He remained in this state for several hours, and then rallied. At the same time, it was noticed that the arteries of the right arm and forearm, which up to that time had pulsated more strongly than those of the left, had become pulseless. The only probable explanation of this train of symptoms is, that a portion of the clot in the sac had fallen into the subclavian artery, and closed it. The arm was partly paralyzed for some time; but ultimately the anastomosing vessels enlarged, and the patient was in all respects cured.

This process of cure by impaction seems generally to occupy a period of at least several hours; but it may be completed very rapidly.

A man was under the care of Mr. De Morgan at the Middlesex Hospital for popliteal aneurism, which was treated by compression of the femoral artery. This gave him so much pain that he was with difficulty induced to keep the instrument on, and Mr. De Morgan, at his urgent request, was about to tie the artery. The house-surgeon was sent for in the afternoon, as the man was complaining of so much pain that he insisted on taking off the instrument. The tumor was then seen to be beating violently. The pressure was removed. *Twenty minutes* afterwards, when he was again seen, all pulsation had ceased, and it did not recur. The tumor, which had been very tense and painful before, became softer; and in twenty-four hours the circumference of the knee diminished one inch. The pain and extreme tenderness subsided at once upon the arrest of the pulsation.[1]

The process of spontaneous cure is very often interrupted. A portion of the sac becomes strengthened by the deposition of clot; but where the circulation is more active, the sac goes on expanding, and either bursts or causes death by pressure on neighboring parts. Often, too, the clot, once formed, is broken down by the force of the stream; or it has been known to be dissected off from the wall of the aneurism, and has been found inverted by the force of the current, so that the convex portion of the clot, which had been moulded to the wall of the tumor, was found turned towards its centre.

Of this, the following case is a remarkable instance. In the Path. Trans., vol. iii., p. 46, 1850–51, is an account by Dr. H. Roe of a case of aneurism of the anterior cerebral artery, which proved fatal, apparently from increase of size and gradually advancing pressure on the brain. The tumor was of the size of a hen's egg, and consisted of two parts, the upper (farthest from the vessel) being almost translucent, and filled with soft yellowish fibrin, imperfectly laminated; while the lower compartment, which directly communicated with the artery, was filled with coagulated red blood, like that in the vessel, and separated from the cavity on the upper surface by a dense laminated mass of fibrin. This mass had attained a considerable degree of organization, containing, with blood discs, very numerous fibres. The convexities of the laminæ were towards the artery and its special compartment of the cavity, or *vice versâ* their *concavities* corresponded with the upper part of the tumor. Dr. Brinton, in a report on this specimen, believes that this peculiar arrangement of the clot resulted from the dissection off the wall of the aneurism of the ordinary laminated clot by blood from the artery, and the subsequent inversion of that clot; in fact, an interruption of the process of spontaneous cure.

[1] Path. Soc. Trans., vol. ix., p. 167.

[1] In another case under Mr. De Morgan's care at about the same time, in which the tumor was rapidly enlarging, although pressure was used to as great an extent as it could be borne, he had intended to tie the artery. On the morning of the proposed operation, however, the pulsation stopped suddenly, according to the patient's account, and it remained absent for about ten hours, and then returned, but not with the same violence. The case ultimately did well under pressure.

In cases where the history can be followed, it usually is found that such interruptions correspond to, and are occasioned by, some unusual exertion or emotion of mind by which the circulation is unduly excited, or some accident in which, perhaps, along with a similar affection of the circulation, the tumor may have been directly injured. Reference has been made above (p. 324) to a case in which the clot continued for a long time to grow without pulsation. In Mr. Prescott Hewett's account of that case, the reader will be struck by the fact, that the cure was not previously a sound one; that the pulsation recurred twice at long periods after the operation; and that, therefore, the clot was probably formed under the influence of a too powerful stream of blood, and so might be looser and less resisting than laminated fibrin usually is. Besides, the fact that the patient was far advanced in phthisis might have modified the coagulability of the blood. Many other cases are on record, in which clots, both after spontaneous and artificial cures, have softened and appeared to become absorbed; but cases in which they grow without pulsation are rare.

In a case reported by Freer, Obs. on Aneurism, p. 106, and quoted by Broca, a very large aneurism had been rapidly obliterated by pressure, but had never much diminished in volume. *Twenty-two years* afterwards, the tumor having grown during the interval to an enormous size, but without pulsation, it burst, and a mass of brown grumous material was discharged. The patient died, worn out by fever and suppuration. It may be noticed, that in these cases where the clot afterwards softens, it is usually remarked at the time that the aneurism does not diminish much in size after its apparent cure. This then is to be regarded always as a suspicious circumstance.

I have seen two distinct examples of this increase in size without pulsation—in one the artery had been entirely divided, and the sac afterwards gave way. Amputation became necessary from the bursting of the tumor through the skin. In the other the aneurism was nearly cured, but its size and the consequent obstruction to the circulation caused gangrene, and hence amputation was performed.

After the cure of aneurism is completed, *i. e.*, after the whole cavity is filled with laminated clot, no further change takes place in the swelling except a decrease in size, very perceptible at first, while the fibrin is in the process of contracting, and which proceeds slowly for a considerable time, until the clot has assumed its condition of greatest density, in which condition it may remain during the rest of the patient's life. By this gradual contraction of the clot, small aneurisms are reduced to a size imperceptible to external examination, and sometimes can hardly be recognized even by dissection. The collections which used to be described as "steatomatous or atheromatous tumors of arteries" were probably small cured aneurisms. But in swellings of larger size the laminæ of the clot remain distinct, though usually decolorized, during an indefinite period. Other changes, however, sometimes take place in aneurisms which appear to be permanently cured. These, probably, depend on the imperfect or loose formation of the clot; though later on, the wall of the tumor takes part in the action. Thus the clot may be found softened and changed into a grumous material (as in Freer's case), or suppuration may take place, perhaps, from the irritation of this decomposing fibrin, and the whole mass be ejected. This took place a year after the apparent cure of the disease in a case operated upon by Sir W. Lawrence.[1] Finally, the clot has been found more or less mixed with cretaceous matter.

Symptoms and Diagnosis of Aneurism.

The symptoms of aneurism may be easily inferred from its definition. A tumor containing blood and communicating with an artery will, in all ordinary circumstances, receive pulsation from the artery; it will be situated on the course of the vessel, and will be incapable of being removed from it; it will (so long as part of its contents are fluid) diminish in size when the circulation through the vessel is stopped by pressure on the artery above, while, on the contrary, some increase in size may be sometimes observed when pressure is made below the tumor; and, after the circulation has been stopped and the tumor emptied as far as possible, it may be seen to fill again gradually, and in a certain definite number of beats of the pulse, when the pressure is withdrawn. Besides these symptoms, which may be observed in every case of external or surgical aneurism, the two following must be borne in mind, which, though not always to be found, are so constantly present as to make them of great value in diagnosis. First, that the pressure of the tumor, and the diverticulum which it forms for the arterial current, will usually cause a diminution in the force of the pulse on the affected as compared with the unaffected side; and secondly, that the pulsation is usually accompanied by a peculiar rough blowing sound, called the aneurismal bruit. The assemblage of

[1] Med. Chir. Trans., vol. vi., p. 204.

these symptoms furnishes as decisive evidence of the nature of the disease as it is possible to have of anything not actually under our eyes; and as it is rare for those which are most characteristic to be absent in external aneurism, the diagnosis does not generally present any great difficulty. In internal aneurism, *i. e.*, aneurism seated in the chest or abdomen, it is very different; the tumor is often imperceptible, or if perceptible by percussion, or even by palpation, yet the course of the vessels is so far from the surface, and the tumor may extend so widely, that it is impossible to be sure that the tumor corresponds exactly to the position of an artery. The pulsation is frequently imperceptible, or may be derived from the near proximity of the heart or great vessels, without any real connection with them—a frequent cause of error in the diagnosis of tumors, especially in the abdomen. It is impossible to stop the circulation above, and watch the tumor refilling; the inequality of the pulse on the two sides, though very useful as a corroborative symptom, may be produced by a great variety of other causes, and the aneurismal bruit is very frequently absent. Hence, while the surgeon can usually pronounce a perfectly clear and unhesitating opinion as to the existence of aneurism in the limbs, the physician is beset with so many difficulties, that although they in general pay more attention to diagnosis, and therefore may be presumed to excel more in that branch of our art, the ingenuity of physicians has not succeeded as yet in pointing out any unmistakable signs of internal aneurism; and in many cases, even where the strongest reason exists for suspecting its presence, it is impossible to come to a certain conclusion during the lifetime of the patient.

It is worth while to study the above-mentioned general symptoms of aneurism a little more in detail, particularly with reference to their bearing upon diagnosis. The diseases with which aneurism may be confounded are, tumors, or abscesses, lying upon the course of large arteries, and malignant tumors of bone, which sometimes pulsate from the development of large blood-cavities in them; further, it is necessary to distinguish between aneurism and a mere enlarged and relaxed condition of the artery, in which pulsation is much more perceptible than usual. In the first place, then, an aneurism is a tumor contained in a cyst or sac; it is therefore separable from other parts, which latter, if no inflammation has taken place, can usually be felt to glide upon it, and is more or less movable according to the depth of its connections and to the extent of its base. Next, as to the nature of its contents. These are, perhaps, more commonly a mixture of clot and fluid than merely fluid blood, and it is rare, therefore, to find pulsation equally perceptible in every part of the tumor. The character of the pulsation, it must be remembered, depends on two things; on the nature of the contents, and on the condition of the orifice. The usual character of the pulsation of an aneurism is that of a wave, gradually swelling up and gradually subsiding. There is also a lateral expansion of the tumor, so that if the two hands be pressed on its opposite sides, they will be seen to separate as the aneurism expands. There is usually superadded to this general heaving, when the artery lies between the sac and the hand of the observer, a distinct line of more rapid and thrilling pulsation, which marks the course of the vessel. This may generally be observed very plainly in popliteal aneurisms which are growing towards the knee-joint, and have the artery crossing them. The heaving character of the pulsation in aneurism differs from the more rapid and simultaneous pulsation of all its parts in a vascular tumor, which pulsates from the presence of a number of large vessels, and in which, therefore, the movement commences at all parts of the tumor, instead of being propagated from one. It differs equally from the movement communicated to a tumor by a large vessel lying beneath it, which is simply a rise and fall. The extent and power of the pulsation in an aneurism depend usually upon the amount of clot in the sac; and thus the gradual decrease of pulsation may be watched from day to day, as an aneurism is becoming consolidated under the use of pressure.

Pulsation may be obstructed by clots lying about the mouth of the aneurism, and sometimes may be altogether absent, although the sac still contains fluid blood. These are the most difficult cases in respect of diagnosis, which is then inferential merely, and almost as obscure as in internal aneurism. The cause of the absence of pulsation in an uncured aneurism is often very obscure. In some cases it appears to be due to the obstruction of the mouth of the sac by loose coagula. In one case of popliteal aneurism, I thought that pulsation had disappeared in consequence of rupture of the artery and aneurismal sac during the use of flexion. A free rent in the sac, like the total rupture of an artery by violence, is usually accompanied by disappearance of pulsation. Sometimes the pulsation may even have disappeared, in consequence of the tumor having been spontaneously cured, and yet its size and interference with the functions of the limb may cause the patient to apply for advice to a sur-

geon who has not seen it during its earlier stages. In such a case as this the patient's account of the previous symptoms, if he be a person of intelligence, will be of great value, while, if he can give no account of the disease, the diagnosis will be probably uncertain. Such was the case in the patient mentioned on p. 332.

The pulsation can be made to cease at once by pressure on the artery above the tumor—a character common, of course, to all tumors which derive their pulsation from the vessel, whether by continuity with it or not; whether aneurisms, enlarged glands, abscesses, or anything else pressing on the artery. Pulsation in an aneurism is always more powerful than in the arteries leading to it, while the sac contains much fluid. This is a consequence of the powerful reaction between the wave of fluid and the walls of the sac (see p. 323).

The gradual return of the tumor to its full size, after it has been emptied by pressure, the circulation having been stopped, is another feature very characteristic of aneurism; and it is important to note the variations in this respect, which will be observed in an aneurism as it is gradually filling with clot. The more fluid the sac contains, the more completely will it be emptied, and the more readily will it fill. As the deposit of clot proceeds, the beat becomes less forcible, and the tumor varies less in size on pressure upon the artery. It should not be forgotten, that since pulsation is caused by the reaction which the parts around exercise against the impulse of the heart, it depends for its perfection upon the integrity of the sac; hence it is frequently not present at all when there is no sac, as in rupture of an artery before a sac has formed. Thus, in a case where the patient had been caught by some machinery in motion, and the leg violently twisted, much ecchymosed blood was found in all parts of the limb below the popliteal space, but no pulsation ever appeared in this collection. The limb was amputated about a fortnight after the accident, on account of gangrene, when the popliteal artery was found broken completely across. So in aneurisms which, after advancing rapidly, suddenly burst with a large rent, the pulsation often vanishes completely; to recur, perhaps (if the accident is not fatal), when the rent has healed.[1]

Having clearly before us the symptoms of surgical aneurism, the following rules may be laid down for its diagnosis from each of the affections above spoken of.

Diagnosis of aneurism from tumors pressing on the artery.—The greater number of tumors which lie against an artery do not cause any bruit. If they do produce any sound, it is a mere dull short beat, or "thud," as it is sometimes called, and may in these cases usually be imitated by pressing the stethoscope firmly on any large superficial artery. On the contrary, the bruit of an aneurism is usually a somewhat prolonged rasping or blowing sound, and cannot be artificially produced in a healthy artery.

The pulsation communicated to a tumor, or abscess, lying over an artery, is an equable rise and fall, which ceases entirely when the pulse is stopped, and recurs at the first renewed beat of the artery as strongly as ever. The pulsation of an aneurism is generally a wave of fluid, which, on the removal of pressure from the vessel, does not attain its greatest height till after a certain number of pulses, and which causes not merely a rise and fall of the tumor, but also an expansion in every direction. The surest diagnostic sign, however, is, that the tumor can be dragged away from the vessel, while the aneurism cannot; but this is not always the case, since the tumor may be too deep, or too tightly bound down by fascia, or too closely adherent to the artery, to be moved. To this it may be added, that if the swelling be an abscess, the symptoms of that affection will sometimes be present; but the occurrence of suppuration around, or in, aneurismal sacs must be kept in mind; so that too great stress should not be laid upon the symptoms of suppuration, as if they excluded the notion of aneurism; and in any case in which there is doubt whether the swelling is an abscess or an aneurism, auscultation should be carefully used, since the rough aneurismal sound will prove that, even if it be an abscess, the swelling communicates with the neighboring artery.[1]

Pulsation may, however, be caused by the tumor being, as it were, inclosed in arteries. This was the case in a patient in whom Mr. Moore tied the common iliac artery, on account of a pulsating tumor situated exactly in the position of an aneurism of the external iliac artery, and having "a rough and loud

[1] See also the case on p. 320.

[1] Great caution is needed in dealing with tumors lying near large arteries. Broca (p. 427) relates that of the four successive senior surgeons of Hôtel Dieu, Ferrand, Desault, Pelletan, and Dupuytren, the others each opened an aneurism by mistake for an abscess, and Pelletan laid open a malignant pulsatile tumor, intending to perform the old operation for aneurism. Mr. Erichsen has recorded three cases which came under his own notice at University College Hospital in which aneurisms had been treated as abscesses, and in two of the cases had been opened (Lancet, Oct. 7, 1868).

murmur." On dissection it was found that the tumor was formed by cancer deposited in a mass of glands situated in the bifurcation of the common iliac, between the internal and external iliac arteries, closely bound down to those vessels, and particularly to the external iliac, by an envelope of fascia, having the obturator artery beneath it, and perforated by the gluteal, sciatic, and pudic arteries. In this case, though the question of aneurism or pulsatile malignant tumor was discussed, it was found impossible to establish the diagnosis of its cancerous nature; nor, after death, could any means of diagnosis be suggested, except that the urine in the bladder contained cancer-cells, which might perhaps have been found by microscopic examination. But as the only specimen of urine which had been seen was quite clear, it is possible that the cancer-cells might have been only occasionally present; and it must be allowed that no means of certainly diagnosing such cases are known at present, since, from its shape and depth, the tumor separated the fingers as it rose, so as to simulate the expansive pulsation of aneurism, and the sound was not appreciably different from what is found in many aneurisms. Even had the tumor been more superficial, it was so surrounded and penetrated by large arteries, that its pulsation could not have been stopped by drawing it away. This was the fifth case in which the common iliac artery has been tied in London; and, out of these five, it was the third in which the disease was supposed to be of aneurismal, but proved to be of malignant, nature (Med.-Chir. Trans., vol. xxxv., p. 468). A case occurred in Mr. Paget's practice, which still more strikingly illustrates the difficulties of diagnosis which beset pulsating tumors lying near the large arteries in the abdomen. A man was admitted for pulsating tumor in the groin and iliac fossa. Much doubt existed as to its nature. Most of those who saw it inclined to the opinion that it was aneurismal; others thought it malignant. It was decided to cut down on the external iliac, and, if the tumor appeared to be an aneurism and ascended too high to allow of this vessel being secured, then to tie the common iliac. The operation was performed accordingly; but the false pelvis was found filled with a large mass, partly solid, and not pulsating, which so displaced the arteries that it would have been hardly possible to tie the common iliac. However, under the impression that the tumor was malignant, the attempt was not made. The tumor fungated out of the half-healed wound of the operation, and the man died of arterial hemorrhage. It was then found that the tumor was really aneurismal, and partly consolidated.[1]

Mr. South[2] mentions a case of varix of the internal jugular vein, preserved in the museum of St. Thomas's Hospital, which encircles the artery, filling nearly the whole side of the neck, and notices the difficulties which must arise in such cases in separating the pulsation of the tumor from that of the artery round which it is, as it were, folded. In the case of a varix, Mr. South thinks that it might be distinguished "by pressure of the swelling at its farthest extremity from the heart, in which case its size will diminish; whilst if pressure be made between it and the heart, its bulk must be increased, which is the very reverse to aneurism.[1]

Diagnosis between aneurism and pulsatile tumors of bone.—The diagnosis between pulsatile tumors of bone and aneurism is very difficult; so that many of our best surgeons have been deceived by the resemblance. The diagnostic symptoms are the following, but they are seldom or never all present together: 1. The bruit seems but rarely as well marked in pulsatile tumors as in aneurism, and is often altogether absent. "It is true," however, as Mr. Stanley remarks,[2] "that in states of general anæmia, also in diseases of the aortic valves allowing of regurgitation, limited portions, or even the whole, of the arterial system, without organic change in the vessels, may impart to the stethoscope a murmur approximating to the bellows-sound of aneurism. And if, under such circumstances, a tumor should happen to form in any region of the body, so close to a large artery as to influence its pulsations, then, by the stethoscope, the bruit or bellows-sound may be recognized in the artery as forcibly as in an aneurism." 2. The pulsation is usually more sudden, less heaving, and less expansive in the pulsatile tumor, and is equally forcible over the same space of tumor, whether the latter be large or small; while in aneurism the bulk of the swelling and the force of its pulsation increase and decrease together. 3. The condition of the bone with which the tumor is connected will often aid in the diagnosis. Thus, in Mr. Stanley's case (Med.-Chir. Trans., vol. xxviii., p. 318), a plate of bone was found in the walls of the tumor. In another, which I saw at St. George's Hospital some years ago, where a pulsatile tumor of the ilium projected in the buttock at the situation of the sacro-sciatic foramen, and closely resembled in many respects an aneurism of the gluteal artery,

[1] Brit. Med. Journ., 1858, p. 724.

[2] Chelius, vol. ii., p. 202.

[1] A case will be found in the Med.-Chir. Trans., vol. xxviii., p. 314, in which Mr. Earle tied the subclavian artery on account of a supposed axillary aneurism; which, however, turned out to be a tumor connected with the median nerve. It is to be regretted that nothing is said about the symptoms beyond the general statement that "the tumor presented all the characters of aneurism."

[2] Med.-Chir. Trans., vol. xxviii., p. 316.

the diagnosis was correctly established by observing fulness in the iliac fossa, the ilium being expanded on both sides by the tumor developed in it.[1] When an aneurism, on the contrary, eats through a bone, it simply chisels out a hole in it; so that if the sac can be emptied and made to collapse, the edges of the hole will be felt. 4. These pulsatile tumors of bone appear to be always, and certainly are usually, cancerous; so that the general symptoms of the cancerous cachexia may be present, or some other cancerous tumor may be seen. In the pulsating tumor in the buttock just mentioned, the presence of hæmaturia at a later stage of the case revealed the existence of mischief about the kidney, which was found after death to depend on the deposition in that organ of a large mass of encephaloid cancer. It must be admitted, however, that the diagnosis between pulsatile tumor and aneurism is often a matter of the greatest difficulty, even if it be possible; and that the diagnosis of cases of aneurism unaccompanied by pulsation, such as those mentioned on pp. 324, 336, is sometimes impossible.

[In a case of large pulsating tumor of the buttock under the care of Prof. Sands in the Roosevelt Hospital, N. Y., in the spring of 1880, the diagnosis of aneurism was made by introducing the hand into the rectum, and thus discovering that the internal iliac was greatly dilated, the dilatation increasing regularly from above downwards to the sacro-sciatic notch (Am. Journ. of Med. Sc., April, 1881).]

Two cases which occurred lately at St. George's Hospital illustrate (among a great many which might be quoted) the difficulties which beset the diagnosis between aneurism and pulsatile tumor of bone. One was the instance of aneurism of the ulnar artery caused by impaction of clot, figured on p. 321. In this case no operation was proposed, as the boy was in an advanced stage of cardiac disease, but the case was shown to the surgeons in consultation, and the appearance of thickening around the ulna in the neighborhood of the tumor led the majority to regard the case as one of pulsatile cancer.—The second case was one in which almost all the symptoms of popliteal aneurism were present, though not very well marked—there being a distinct though not loud bruit, and an expansive pulsation, though not a very powerful one. It was thought more probable that this was a case of aneurism, in which the sac was partly full of soft clot; and, although the possibility of pulsatile tumor was not denied, it was decided that the artery should be tied, pressure having been previously tried without benefit. The patient died some weeks afterwards of phlebitis, and it was then found that the disease was pulsatile cancer of the femur.

[1] In Mr. Stanley's case also the tumor projected on both sides of the ilium.

Diagnosis between aneurism and aneurismal dilatation.—The diagnosis between an aneurism and a mere dilatation is usually quite obvious, at least between extreme examples of the two. The dilatation is generally unaccompanied by any distinct tumor or by any aneurismal bruit. It contains no clot, and hence may be completely emptied by pressure on the artery above, filling at once when that pressure is removed; and there is usually no interference with the pulse in the arteries below the disease.

Treatment of Aneurism. The Old Operation.

The medical treatment of aneurism has been discussed sufficiently for the purposes of a work on surgery. It now remains for us to consider the various plans of local treatment which are in use in ordinary or encysted aneurism, and to point out, as far as our present experience enables us to do so, to what extent and in what cases each plan is likely to prove useful.

The first method of treatment, usually called the old operation, or the method of Antyllus, aims at the entire eradication of the aneurismal tumor.[1] The operation is thus performed: the artery above the seat of the aneurism is to be commanded, if possible, by a tourniquet, or by the finger of an assistant; then an incision is to be made into the tumor, care having been taken to expose it by a sufficient dissection of the superficial parts, should these involve any important structures; the clots are then to be rapidly turned out of the sac, and the orifice by which it communicates with the artery is to be searched for; a ligature is then to be placed on the vessel above and below[2] the

[1] Perhaps I ought to mention another method of eradicating an aneurism, viz., by caustic. Thus Nélaton destroyed a small bleeding tumor, resulting from a ruptured traumatic aneurism of the palmar arch, by means of chloride of zinc (Journ. de Méd. et Chir. prat., May, 1862). This method, however, can only be used on superficial tumors of small size and connected with small arteries.

[2] Keyslère, a surgeon of Lorraine, but practising in Italy, who appears to have re-introduced the method of Antyllus into Italy, used only one ligature above the tumor. Three of his cases are reported by Testa of Ferrara (who seems to have learnt the operation from him), of which two were successful. Mazotti, who had seen Keyslère operate, used two ligatures generally, but not always (Pelletan, Clin. chir., vol. i., p. 142).

aneurism. The opening of the vessel can be found by passing a probe from the sac, first upwards and then downwards, in cases where a distinct sac is found; but in "diffused" aneurism this is often impossible, according to Pelletan. When the ligatures have ulcerated through the vessel, and the cavity has been filled up by suppuration and granulation, the tumor is radically extirpated.

Such is the description, in general terms, of an operation which, thus stated, appears simple enough. Its difficulties, however, are often of the gravest character when the aneurism is deeply seated, when the artery communicates with its deepest part and when the sac contains recesses or is closely united to the parts around. Besides its difficulty, it is often an extremely severe operation, requiring an incision of extraordinary length,[1] necessarily involving considerable hemorrhage, and leaving an enormous cavity to fill up. The records of ancient surgery show that it used to be often a tedious and desperate proceeding, which sometimes proved fatal on the spot, and the success of which was at all times very uncertain. Hence it has been superseded in almost all cases, and few living surgeons have much experience of it. In popliteal aneurism, for which it used to be the only cure except amputation, it is now completely abandoned, having given place to milder and more certain methods. In femoral aneurisms, compression or the ligature of the external iliac would always be preferred; and so on for most of the common species of surgical aneurism. There are, however, some situations in which the old method still holds its ground in the estimation of at any rate some surgeons. In axillary aneurism it has lately been recommended by the high authority of Mr. Syme, and enforced by the example of his successful application of it. In aneurism of the gluteal artery, should that rare disease be met with, many surgeons would prefer cutting down on the sac and turning out the clot, especially in a traumatic aneurism, to the still more dangerous operation of securing the internal iliac artery;[2] and in traumatic aneurism at the bend of the elbow, if the disease resisted the proper application of pressure, it would perhaps be considered more safe to open the sac and tie the artery above and below, and would involve no more danger to life. Besides these, cases will every now and then be met with in which, the diagnosis having been uncertain, the tumor is cut into with a view to tying the artery above and below it, if it prove aneurismal, or amputating if it be cancerous.[1] In some cases also, after the bursting of the sac, the artery can be secured in this way and amputation avoided.[2]

[The old operation has recently been used successfully in three cases of recurrence; two of femoral aneurism after ligation of the external iliac, and one of popliteal aneurism after ligation of the femoral. In June, 1875, Mr. Annandale (Lancet, April 22, 1876, p. 597) tied the external iliac with the effect of almost curing a femoral aneurism in Scarpa's space; some pulsation remained in the tumor, and in January, 1876, the latter was found to have much increased in size, and the pulsation to have become stronger. A tourniquet was applied to the femoral artery below the tumor, and a Lister's tourniquet to the abdominal aorta; the sac was laid open, the clots removed, and the orifices of four vessels which bled considerably were recognized. At Mr. Lister's suggestion, metal bougies were passed into these openings to arrest the bleeding and to serve as guides to the vessels; the latter were then isolated and tied with catgut. The wound was treated antiseptically, and the patient made a good recovery.

In the second case, Dr. J. C. Hutchison, of Brooklyn (Am. Journal of Medical Sciences, Oct. 1880), tied the external iliac in March, 1874, for an aneurism situated just below Poupart's ligament. In September, 1878, the aneurism returned, and, after trying pressure and the repeated injection of the persulphate of iron unsuccessfully, Dr. Hutchison laid open the sac Dec. 24, 1878. A rubber tube was applied around the thigh below the tumor, and the abdominal aorta compressed by a tourniquet. Although pulsation in the tumor was arrested by the tourniquet, the bleeding was free from a vessel which opened on the inner side of the sac, supposed to be the internal circumflex; it was arrested by the introduction of a rubber bougie into the orifice of the vessel. "The artery was secured with much difficulty by seizing its mouth on either side with tenacula and drawing it forward, the bougie still acting as a plug; a ligature was thrown around it and tightened as the bougie was withdrawn." The ligature came away on the 24th day, and the patient made a good recovery, although the occurrence of gangrene seemed imminent at one time.

[1] In a successful case, Pelletan made an incision ten inches long in operating on a recent popliteal aneurism, which is not stated to have been of remarkable size.

[2] But the diagnosis must be made with certainty. See above, pp. 338, 339. In Mr. Syme's Observations in Clinical Surgery, 1861, pp. 165–173, will be found two interesting cases of gluteal aneurism, treated, one by the old operation, the other by ligature of the internal iliac artery, and both with success.

[1] Gay, Lancet, 1868, vol. i., p. 780.

[2] Birkett, Med.-Chir. Trans., vol. l., p. 431. Cooper Forster, Clin. Soc. Trans., vol. i., p. 36.

In the third case, Mr. Annandale (British Med. Journal, April 17, 1880, p. 587) observed a recurrent popliteal aneurism in a man of 36, formed by rupture of the sac seven years after cure by ligation of the femoral. The tumor had grown in three weeks to the size of an orange, was extremely painful, and had neither bruit nor pulsation. Mr. Annandale laid it open, after having placed a rubber tube about the thigh to prevent bleeding, and found it full of recent clot formed of blood that had escaped from the old aneurism through a small rupture in its wall. He then opened the sac itself, recognized the orifice of communication with the popliteal artery, and tied the vessel above and below. The patient recovered promptly under antiseptic treatment. Strictly speaking, this was a "ruptured," not a "recurrent," aneurism.]

The leading idea of the old surgeons in operating upon aneurisms was doubtless an erroneous notion that it was necessary to get rid of the clot, which they believed to have vicious properties, and to be injurious both to the part in which it lay and to the constitution of the patient. So that they turned it out, not merely that they might find the mouth of the artery, but also, and mainly, in order to rid the constitution of so dangerous a secretion; and stuffed the cavity with compounds which they believed to have the property of preventing the reproduction of coagulum. All this theory is of course exploded now; and if the operation were undertaken in any case where there was much clot, the only object of the surgeon in disturbing that clot would be to find the mouth of the sac. Still, when the clot has been disturbed and exposed to the air, it is better to remove it; and thus a large cavity is left to be filled up, and the extensive suppuration which this involves accounts for a large percentage of the great mortality after this procedure. Gangrene was very common after the old operation for popliteal aneurism, possibly from the difficulty of distinguishing the parts from each other, and the consequent frequency with which the vein and sometimes the nerve also was included in the ligatures. Another and a very frequent cause of death was the great liability to secondary hemorrhage involved in this method as it used to be practised on diseased arteries. When used for traumatic aneurism, this objection does not apply, since the artery is as likely to be healthy in the neighborhood of the wound as in any other part; but spontaneous aneurism usually occurs in consequence of atheroma in that part of the vessel; it is probable, therefore, that the ligatures will be applied to a brittle, degenerated artery, and will cut it through before any union has taken place. This danger, it is true, accompanies the Hunterian operation also, though to a less extent,[1] and there is more probability of finding the coats of the artery near the tumor sufficiently healthy for the application of the ligature in external than in internal aneurism; but even in the arteries of the limbs the neighborhood of the tumor is the most insecure place at which an operation can be practised; and this was the main theoretical reason which set Hunter upon thinking of a new operation for aneurism.[2] The practical reason was doubtless the excessive mortality occasioned by the above-mentioned causes, and by the hemorrhage during operation, which, in all cases where no tourniquet could be applied, was frightful, and sometimes instantly fatal,[3] and which was often severe even when the artery was commanded above the tumor, since, in a deep sac, it was necessary to let the vessel bleed in order to find its mouth. What the mortality was after this operation, practised as it usually was in the popliteal space, we have no means of judging, except by consulting the works of those surgeons who, like Pelletan and Roux, have left the records of their individual experience; and it cannot be too often repeated that such data, though useful in many respects, are untrustworthy as statistics. Statistics of operations to be of any use or authority must be founded not on cases arbitrarily selected for publication, not even on the individual experience of distinguished operators, however fully and frankly given to the world, but on the general experience of large hospitals, embracing

[1] Especially in the arteries of the belly. See the account of an operation on the external iliac artery by Sir W. Fergusson, Med. Times, vol. ii., 1855, p. 567. See also infr. on Abdominal Aneurism.

[2] "Mr. Hunter, finding an alteration of structure in the coats of the artery previous to its dilatation, and that the artery above the sac seldom unites when tied up in the operation for aneurism, so that as soon as the ligature comes away the secondary bleeding destroys the patient, was led to conclude that a previous disease took place in the coats of the artery. . . . Mr. Hunter, from having made these observations, was led to propose that the artery should be taken up at some distance from the diseased part, so as to diminish the risk of hemorrhage, and admit of the artery being more readily secured should any such accident happen. The force of the circulation being thus taken off from the aneurismal sac, the progress of the disease would be stopped; and he thought it probable that, if the parts were left to themselves, the sac with its contents might be absorbed, and the whole of the tumor removed, which would render any opening into the sac unnecessary." —Hunter's Works, vol. iii., pp. 596, 598.

[3] Roux, Quarante Années, etc., vol. ii., p. 46.

every case indiscriminately for a long series of years.[1] This has never yet been fully effected, and till a very few years ago was entirely unthought of. The mortality of every operation in ancient times must have been high, since the after-treatment was far more arbitary and artificial than at present; but what the proportion of deaths may have been we cannot now ascertain. Pott, in the well-known passage referred to on p. 333, says of this operation: "I have tried it myself more than once or twice; I have seen it tried by others; but the event has always been fatal;" and Wilmer of Coventry said that in the year 1780 there had not occurred in this country one well-authenticated case of success. However, in Pelletan's Clinique chirurgicale (vol. ii., pp. 117–144) there will be found notes of four operations of his own and six practised in Italy, in which success is claimed in no fewer than seven cases; and in Roux's Quarante Années (vol. ii., p. 468) the only two recorded cases of the operation on the popliteal or femoral artery by opening the sac were successful. It is probable, therefore, that Pott's view of the mortality of the operation was too gloomy; although the immediate success of the introduction of the Hunterian operation shows that the old method must have been far more fatal. Now the Hunterian operation on the femoral artery, as practised at present, gives, as we shall see, a mortality equal, or nearly so, to that of amputation of the thigh;[2] consequently the proportion of deaths after the old operation must have been something frightful.

The risk of hemorrhage during the operation is a very formidable one when no tourniquet can be applied. Mr. Syme, however, has succeeded in several cases in getting through these dangerous operations without fatal hemorrhage by the same expedient as he uses with such success in tying the vessels for wound; a proceeding to which the operation under consideration bears much analogy. He opens the sac at first by a moderate puncture, which allows him to introduce a finger into the sac and feel for the opening of the vessel. If the puncture is not large enough, he dilates it so as to get in one and another finger,[3] until the point is discovered at which the pressure of the fingers arrests bleeding. Meanwhile the opening in the skin is of course plugged by the fingers which have been thrust into it, so that no great gush of blood takes place. When the orifice of communication between the sac and the vessel has thus been commanded, the sac is opened freely and cleared of clots. Then the vessel is raised with forceps, if it is fairly visible, and tied. If the artery is not exposed, the operator must keep his finger still pressed on the orifice, while, with the aid of his assistants, he scratches away the tissues that obscure it.[1] Further reference to these operations will be made in the sections treating of Carotid, Axillary, and Gluteal Aneurism.

[1] If it were possible to obtain reliable and unselected data from private practice, they would of course be equally useful; but this as yet has not been found possible.

[2] I do not, of course, mean that the operations are equally severe, but that about the same number of patients die after each. This is probably to be accounted for by the state of the circulating system and of the constitution, which gives rise to aneurism.

[3] In one case the whole hand was inserted up to the wrist.

The Hunterian Operation by Ligature.

The treatment of popliteal aneurism by ligature is one, and perhaps the most perfect, of the many discoveries of modern surgeons.[2] It reduced a disease, which before was almost uniformly fatal, to the position of one of the most manageable of all serious surgical affections. It is true that in still more recent times a method has been discovered which is usually successful at even less risk to life; but this method of compression, though, as we shall see, it may commonly be reckoned upon in popliteal aneurism, may fail even there, and there are many arteries to which it is inapplicable; so that the Hunterian operation of tying the artery above the sac still is, and probably will long remain, the last resource of surgeons in the graver cases of aneurism. Of so great a discovery and so happy a triumph of our art over difficulties which we, who have been taught how to combat them successfully, cannot estimate in their full magnitude, the history is always interesting, and the right appreciation of the claims of rival inventors is a matter of no slight importance. Unfortunately the limits of the present work do not allow of an adequate discussion of this

[1] A good description by Mr. Erichsen of this operation will be found in the Lancet, 1868, vol. ii., p. 504.

[2] It is not intended to assert that the practice of tying arteries is a modern invention. "The Greek and Arabian physicians," says Mr. Hodgson (op. cit., p. 187), "more especially Ætius and Paulus of Ægina, distinctly recommended the ligature of the brachial artery a few fingers' breadth below the axilla for the cure of aneurism at the bend of the arm." But, like many surgical inventions of the ancients, it had been lost until its reintroduction by modern surgeons in a more complete and more practicable shape.

subject, so that all that can be said about it must be comprised in a very few words, and it is more with a view of avoiding ambiguity or difficulty in reading foreign books, than of writing a portion of the History of Surgery, a task which is not attempted in the present work, that the following brief account is inserted of the rival claims of Hunter and Anel to the honor of giving his name to the operation now in use. This operation consists in securing the artery by a single ligature at a distance from the sac, and between it and the heart. The student will always bear in mind in reading most of the modern French works on surgery, that they intend by the "méthode d'Anel" the same thing as English, German, Italian, and American writers do by "the Hunterian operation." The essential differ-

[Fig. 316.

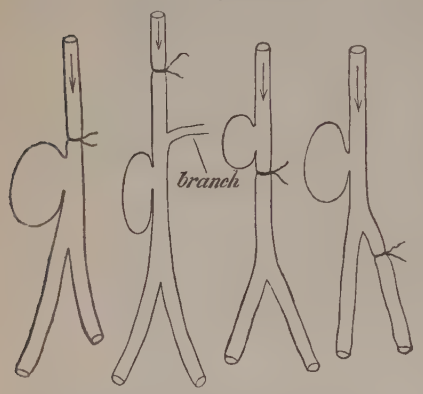


Diagram showing the different operations for aneurism.]

ence between Hunter's and Anel's methods has been shown so often and so clearly, that although I think it necessary again to expose it in this place, this will be done only cursorily, and as little space as possible will be wasted upon a question which has become rather personal than scientific.

The old method of operating for aneurism has been discussed, and its radical error has been seen to be, that its authors confounded what is in reality the effort of nature for the cure of the disease, viz., the deposit of laminated fibrin, with the essence of the malady itself; and instead of striving to encourage and promote this deposit, thought it necessary to undertake a severe operation for the purpose of removing all such clots from the system. Another, and hardly less fatal, objection to its general application was that, as the old surgeons never contemplated the possibility of a cure of the aneurism without the entire suspension of the circulation, it was necessary, in their view, to tie the artery close above the tumor, and, this having been done, it was found out that the blood would usually escape from the lower end unless that was also tied.[1] The great merit of Hunter consists in his having avoided both these errors; in his having seen, *first*, that it was not necessary to turn the clots out of the aneurismal tumor, so that no incision was required to open the latter; and, *second*, that it was not necessary to stop the circulation through it absolutely, but only, as he said, "to take off the force of the circulation," so that the artery might be taken up some distance from the sac, and therefore at a part where it would probably be found healthy; and, further, in his perceiving that the ligature of the main artery of the limb does not involve the gangrene of the extremity, but that the anastomosing vessels may be trusted to carry on the circulation.[2]

From these considerations Hunter was led to propose the ligature of the artery at a point some distance above the sac for the cure of aneurism, the result of disease; and that he, at any rate, and his contemporaries thought that he was making a proposition of startling originality, is clear from the terms in which Hunter cautiously recommended it in his lectures, and from those in which Bromfield commented upon what appeared to him its rashness and its dangers.[3] That it was equally new to Anel's countrymen (although seventy-five years had elapsed since Anel's day, during which the operation devised by him might have been expected, had it rested upon any new principle, to revolutionize surgery), is equally clear from a perusal of the pleasant work of Roux.[4] We read there, that while in England the great school of Hunter, and in Italy, Paletta, Vacca, and Scarpa, had everywhere spread abroad the use of the Hunterian operation, the old method was gaining ground more and more firmly in France, until M. Roux himself, after his return from England, reimported Hunter's operation, which, as we shall see, had been performed once by Desault. In fact, he says that it was not without astonishment that the Paris surgeons heard of a practitioner at Angers having been rash enough to apply Hunter's method to a *traumatic aneurism in the bend of the elbow;* the very case on which Anel had operated. So utterly had the memory of this reputed discovery perished with its author. It may, however, be replied that, though Anel's operation failed to attract the same notice as Hunter's, this does not prove that they are not identical in principle; nor does it. Even if it were so, however, there

[1] But some of the old operators used, as we have seen, one ligature only (p. 340, note). This fact should not be forgotten, as bearing on Anel's claims to originality in his invention.

[2] This had, however, been previously taught by Haller (quoted in Scarpa, Wishart's trans., p. 229).

[3] See Hunter's Works, vol. i., p. 547 et seq.

[4] Quarante Années, etc., vol. ii., p. 89.

would be no little injustice in passing silently over the merits of the man who excogitated the principle by profound reasoning, applied it in spite of searching hostile criticism, explained clearly the theory on which it rested, and succeeded thus in forcing the world's attention and imitation in favor of one who was quite ignorant of the true principles on which the cure of the disease must be founded, and who, for anything that appears to the contrary, was guided by pure chance to the selection, on perfectly false principles, of an operation which he never repeated, nor persuaded others to repeat. This would be so had Anel even happened to stumble on the same operation as Hunter; but the truth is, that the operations are perfectly different,[1] and rest on different principles, and that while the one will probably succeed, the other will almost certainly fail in many cases where the aneurism is the result of disease.

The case on which Anel operated has been often quoted, and is very well known. It need not here be related at length. The facts were these: a man had received a wound of the brachial artery in venesection. It is said that a fortnight afterwards an aneurism formed, and the wound reopened and gave rise to hemorrhage, which was arrested by compression; and that after this the tumor became very voluminous. What length of time had elapsed, and what the state of the tumor was when Anel undertook his operation we are not informed. The operation consisted in exposing the brachial artery, tying it as near the tumor as possible, and applying "the proper dressing and bandage." We are not told expressly whether the blood in the sac was solid or fluid; but it appears clear that it was in the latter state, and that the only reason which Anel had for not opening the sac and emptying it of its contents, was that he was able to empty it by pressure. That this was so, appears implied in his own observations on the subject. He says: "Instead of tying the artery above and below the tumor, I only tied it above; and besides, instead of opening the sac, I did not meddle with it, not doubting that the blood which it contained would disappear, having the opportunity of passing towards the extremity of the limb, and that the sac once emptied would not fill again, but its tissues shrivel up, and the tumor thus disappear; and all this occurred as I expected." It seems clear then that, if Anel expected the blood in the sac to pass on towards the hand, that blood must have been fluid, and probably the "suitable dressing and bandage," which he says he applied after the operation, may have had quite as much to do with the cure as the ligature of the artery; and, after all, the case may have been cured by direct pressure, an event not uncommon in recent traumatic aneurisms at the bend of the elbow. This is evidently quite a different operation from Hunter's; the only principle it has in common with his is that of leaving the sac unopened; and few persons who read without prejudice Anel's confused and obscure account of his operation will fail to see that the reason of his not meddling with the sac was most probably that it could be emptied by pressure. This view is again supported by the fact that Heister, who followed Anel's account, and apparently spoke on the authority of his single case,[1] advised its application only in "reducible" aneurisms. Thus it does not appear that there was much of novelty in Anel's method, since it merely consisted in leaving to the fluid contents of the tumor an exit by the lower end of the artery, instead of tying the latter, just as Keyslère had done; and it may very fairly be doubted whether what novelty there was was not a mistake,[2] and whether Anel's case, in spite of its success, is not only another instance of haphazard good fortune. At any rate, the results which flowed from it before the time of Hunter did not seem to testify to the brilliancy of the discovery. The great learning and evident bias of M. Broca have only enabled him to adduce what he calls six instances of operations performed on this plan before the date of Hunter's first operation, a period of seventy-five years. Two of these are related in the loosest way by Bertrandi, as having occurred in the practice of some anonymous surgeon, and were failures. Of the others, one was of the temporal artery, and two others of the humeral, all most probably traumatic, and all very likely curable without difficulty by very simple means. The sixth case is the celebrated operation of Desault. It would be impossible, without taking too much space from more important matter, to discuss this operation fully in its bearings upon the Hunterian method. It is sufficient to say that it was performed on a case of popliteal aneurism of small size, strictly

[1] No better proof of the radical difference between the two operations can be required than is furnished by comparing two consecutive pages of a writer who persists in calling Hunter's method the "méthode d'Anel;" see pp. 509, 510 of M. Broca's work. In the former page he is carefully and judiciously explaining the essential difference in their effect on the collateral circulation, and hence on the patient's chance of recovery; in the second (the passage commencing "étudions maintenant"), he has recurred to his habitual language, and speaks of them both under one common designation. To such an extent is this pedantry of error carried that it is difficult at first to see that in the latter passage the common or Hunterian operation is spoken of under the name "méthode d'Anel," while in the former the same term signifies the now disused proceeding which that surgeon adopted.

[1] Heister, Instit. chirurg., pars ii., sec. i., ch. xiii., § 20, Amstelod., 1739, quoted by Broca, p. 446.

[2] It seems as if Anel expected that the sac would empty itself, and would not again be filled, being ignorant of the reflux current and of the cure by coagulation.

after the method of Anel, *i. e.*, by tying the artery immediately on its entering the sac. It appears (notwithstanding what has been said to the contrary) to have been successful, at least in its immediate results; the ligature separated on the eighteenth day; the tumor burst and discharged its contents on the day following; this wound healed, and the tumor disappeared. The patient died eleven months afterwards of a disease of the tibia, which appears to have been totally unconnected with the operation. This, then, was precisely the same as Anel's operation, and therefore missed the second and third principles[1] illustrated by the method of Hunter, viz., that the artery may be tied at such a distance as still to allow circulation through the tumor, and that the previous increase of collateral branches is not necessary to avoid gangrene, and that therefore the artery may be tied at the most convenient spot.[2]

The practical objections to Anel's method may be thus summed up. It leaves no current through the aneurism except the slight and weak reflux flow from the artery below. Consequently the clot formed will most likely be soft and loose, and the tumor will suppurate. [Experience has shown that the formation of a soft clot is by no means unfavorable to a permanent cure. See section on Treatment by Esmarch's bandage.] It places under the ligature a part of the vessel, which is more likely to be diseased than any other portion. It is, in most cases, the most difficult of all methods of operation, since the artery is pressed back by the projection of the tumor, and is therefore at an unnatural depth,[1] while the operator has not the guide for finding it which a probe passed out of the sac would furnish. For all these reasons it seems that in any case where Anel's method was feasible, the old operation would be equally practicable, and more certain of success.

The foregoing observations will, it is hoped, suffice to justify the use in the context of the name of Hunter in describing the operation which he is not denied to have invented in the form in which alone it is now practised, to have first performed, and to have afterwards, in spite of much opposition, introduced into general favor. If these things do not give claim to an invention, it is hard to see how such an honor is to be attained.

The Hunterian operation consists in tying the artery on which the aneurism is situated, at any convenient distance above the sac. The operation, as it is now practised, differs in many important particulars from that which Hunter used to perform; particulars which have a most material influence upon its success, and which were impressed upon Hunter himself, and upon his scholars and successors, by the teaching of experience. Thus, Hunter used to tie the femoral artery at its lower part (in the fibrous sheath, called from that circumstance "Hunter's canal"), an operation much more difficult

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[1] See p. 344.

[2] It would be unjust to deny the merit of Desault in applying the almost forgotten method of Anel to the treatment of that most formidable affection (as it then was), popliteal aneurism, and still more unjust to deny that the experience thence acquired might possibly, had he survived, and had Hunter not been in existence (in fact had all the circumstances been altered), have conducted him to Hunter's discovery; but it is monstrous to set up Desault, as M. Broca wishes to do, as the rival of Hunter, when, according to his own showing, Desault himself was quite content to pass as Hunter's scholar. "With a self-abnegation," as M. Broca amusingly says, "which his English detractors have been unable to appreciate, this great surgeon, who then had become acquainted with the operation practised by Hunter, did not hesitate to adopt the precepts taught by his illustrious rival" (Broca, op. cit., p. 454). Desault, in fact, was unware of his title to the glory which M. Broca claims for him. As to the insinuation which M. Broca ventures to make, that Hunter was indebted for his operation to Desault by means of Assalini, who, according to him, was present at Desault's operation, and related its details to Hunter shortly afterwards in England, it refutes itself. The Hunterian operation was taken up nowhere more warmly than among the eminent Italians who were proud of being of the Hunterian school, as we have seen above from the contemporary account of M. Roux. Had one of their number conveyed to Hunter from Paris the first idea of the operation for aneurism, we may be quite sure that he, or some of his compatriots, would have said so. Assalini, an Italian surgeon, was the only person present, as far as we know, both at Desault's operation and at the first operation of Hunter. It was mainly through Assalini that the new method of treating aneurism was brought into vogue in Italy. Assalini and all other Italians always speak of that method as Hunter's. Would this have been so had Assalini taught it to Hunter from what he had himself learnt of Desault? But the fact seems to be, that Desault's operation, which was not brilliantly successful, and which he did not put forth as original, attracted little attention from himself or anybody else; and that he had no desire, as he had certainly no right, to claim any priority over Hunter, whose teaching he, on the contrary, followed with great intelligence and great success in the single operation which he had subsequently an opportunity of practising.

[1] I exclude the comparatively rare case of the artery being raised and flattened by an aneurism growing into the deep parts. But here also I should imagine that the difficulty of distinguishing the vessel would incline the operator to resort to the opening of the sac.

and dangerous than the modification introduced by Scarpa.[1] Hunter, in his first operation, brought a large part of the walls of the artery into contact by four broad ligatures, somewhat loosely fastened, conceiving this disposition to be more favorable to the closure of the artery, which he described as taking place by the process of "first intention." His own experience, however, soon taught him to modify his form of ligature, and to use only one string; and the more extended experience and research of his successors (among whom Dr. Jones[2] has deservedly obtained the first place) have proved to demonstration, that the best form of ligature is a single stout thread, drawn tightly: accordingly no other form is any longer in general use.[3]

[1] On this head, see the section on Ligature of the Femoral Artery.

[2] On Hemorrhage. Reference may also be made to Lisfranc: "Thèse de concours des diverses méthodes et des différens procédés pour l'oblitération des artères dans le traitement des anévrismes," Paris, 1834; South's Chelius, vol. ii:, p. 219; Porta, Delle Alterazioni patologiche delle Arterie, etc., Milano, 1845; [and Benj. Travers in Medico-Chirurgical Trans., 1813 to 1818.]

[3] In the American Journal of the Medical Sciences, Oct., 1859, p. 570, will be found a very interesting case, in which Dr. Warren Stone, of Louisiana, tied the common iliac artery with a silver ligature. The ligature was not drawn tight enough to cut through the internal coats of the artery, according to Dr. Stone's judgment; the ends were cut short and turned down, and so left. The patient died, apparently of causes unconnected with the operation, on the twenty-sixth day; but the symptoms after the operation are not fully given. The ligature, however, seems to have fulfilled its purpose. The body unfortunately was not examined, so that the condition of the ligature was not ascertained. It seems to have been intended by Dr. Stone to remain on the vessel permanently, without exciting any ulceration, and therefore without inducing risk of secondary hemorrhage. That this will sometimes, at any rate, be the case, appears by an instance in which I tied the femoral artery for aneurism after the failure of compression. The artery was inclosed by a wire drawn just tight enough to arrest the pulsation of the tumor, then twice twisted and cut off short. The wound did not unite by first intention, but the suppuration which took place beneath it was transient; the ligature never came away, and the man left his bed on the fifteenth day after the operation, the wound having been healed several days before. But if the ligature be drawn too tight it will cut the coats of the artery more than a silk thread would do, and I have seen a case in which secondary hemorrhage rapidly followed the application of a silver ligature. Hence great care is required, in using such ligatures, not to employ too much force.

Professor Lister has recently introduced into practice the method of tying arteries with catgut steeped in carbolic acid—"the antiseptic ligature," as he calls it. Sufficient experience has hardly yet been obtained of this method to justify an opinion concerning it. In a case under Mr. Spencer's care, where a ligature of this kind was under the carotid artery, it was said to have untwisted—though as to this there was some dispute. In a case of amputation under my own care, the popliteal artery was tied with this form of ligature. No secondary hemorrhage took place. The patient (who was in very bad health at the time of operation) died seven days after the operation. I found the ligature perfectly loose; the lips of the cut end of the artery were in apposition, but there was very little coagulum in the vessel. Similar ligatures have, however, been used in many other cases with perfect success. I need hardly refer to the many times in which animal matter has been used experimentally in tying vessels. I should perhaps mention that in one case where Mr. Lister had tied an artery with this catgut, he believed that he found the materials of the ligature several months afterwards in process of organic connection with the parts around.

[Experience accumulated during the last ten years has shown that the antiseptic catgut ligature is to be preferred to silk. Mr. Holmes, writing in 1875 ("Surgery, its Principles and Practice," Am. ed., p. 120, Lea, 1876), says of it, "The constant use of this form of ligature in operations of all kinds, for several years, has convinced me that secondary hemorrhage is far rarer than with the silk ligature, even in wounds which suppurate freely." The catgut is prepared by soaking it for several weeks in olive oil containing 10 per cent. of carbolic acid. Mr. Lister recommends that a small amount of water be added to the oil to prevent the ligature from becoming too hard and insoluble. MacCormac ("Antiseptic Surgery," 1880, p. 139), recommends the following mode of preparation:—

Pure phenol	10 parts.
Water	1 "
Olive oil	50 "

First, melt the phenol in the water with the aid of some heat, and then add the oil, shaking it thoroughly. Steeping for five or six months is needed. The knot should be firmly drawn, and both ends cut short.

The study of several specimens and cases has convinced me that the artery is, as a rule, completely divided, and that the greater security against secondary hemorrhage is due to the fact that the usual sealing of its divided ends, which is accomplished by the union of its inner and middle coats, is reinforced by the prompt production of new connective tissue about the ligature, which latter does not provoke suppuration, and remains undissolved for a longer or shorter time. For the reasons upon which this opinion is based,

and for statistics of secondary hemorrhage and gangrene, see Bryant in The Clinical Society's Transactions, vol. xi., 1878, and Stimson in the American Journal of Medical Sciences, January, 1881.]

Lastly, Hunter was not at first at all careful to avoid including the vein with the artery in the ligature; but this was an error which he soon gave up. So that the more material improvements were devised by Hunter himself; and in principle the first operation which he performed was identical with all that succeeded it.

The effects upon an artery of the application of a ligature have been already detailed in a previous section of this work (see vol. i., p. 463 et seq.). While the changes there described are going on in the artery itself, the process of cure is progressing in the aneurism. We have seen already, that on the withdrawal or diminution of the force of the circulation, the preponderance of the heart being abated, the process of spontaneous cure commences. The ligature acts to a certain extent as Valsalva's method acts; that is to say, it diminishes the force with which the blood distends the sac, and thus gives opportunity for the coagulability of the blood and the resilience of the parts to fill the sac with firm laminated clot, and so effect the cure of the disease. It differs, however, from Valsalva's method in this important particular—that its action is local instead of general, and is therefore incomparably more certain and more safe. As the process by which the aneurism is filled, and the changes which it afterwards undergoes, are to a great extent the same after ligature as in the natural process of cure, the reader is referred on that head to what has been said above. But to that account it must be added, that since the surrounding parts are suddenly relieved from tension by the withdrawal of the expansive force of the aneurism, their resilience, and the compression they exercise upon the tumor, play a much more important part in the cure after ligature than in the spontaneous cure.

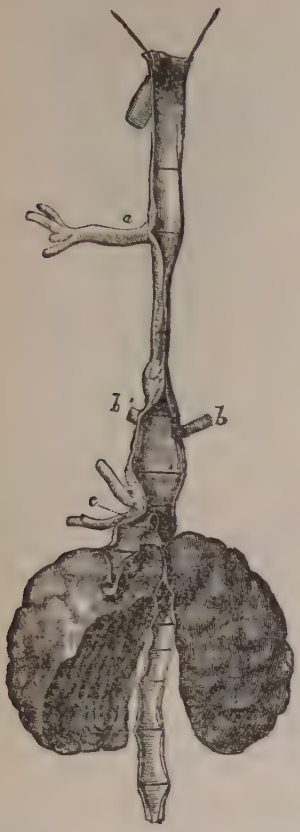
While the aneurism is becoming consolidated, the collateral circulation is enlarging, to convey the blood into the parts below the ligature. The meaning of this term is as follows: when an artery has been tied at any given spot, the next considerable branch which leaves it above the seat of the operation, and in their degree the branches above this, feel an increased pressure, in consequence of the neighboring column of blood having been barred in the principal vessel. Hence they yield to the increased impulse, and become distended. The collateral arteries, by means of which they anastomose with the branches of the parent trunk below the ligature, increase, and increase probably in a much greater ratio than the larger vessels, in proportion to the greater tenuity of their coats. The facility with which the capillary, and other small vessels, allow of changes of volume is well known.[1] Thus a ready way is opened for the blood to return into the parent trunk below the seat of ligature. To make this clear by an example: say that the femoral has been tied (as it generally is) some distance below the origin of the profunda, in a case of popliteal aneurism. The blood will distend the profunda artery and its branches, amongst others the external circumflex and its descending branch; which, joining with the superior external articular, and thus with the anastomotica magna, will be one of the arteries to convey the blood round the ligature back into the trunk of the femoral, below the obliterated spot. The number of such collateral arches of anastomosis is uncertain, but probably they are numerous in most cases, and include, not named arteries only, like that above adduced as an example, but a number of muscular and other branches, the anastomoses of which are so fine in the healthy state, that they escape our ordinary methods of injecting.[2]

[1] The enlargement of the collateral vessels must depend upon the presence of some oxygen in the blood, as well as the sufficiency of the vis a tergo of the heart. If the former be absent, there is no attraction of blood to the capillaries in the distant part of the limb; and a local asphyxia, followed by gangrene, must ensue. Deficient vis a tergo would show itself by pallor and coldness, with shrinking of the distal parts; a defective capillary attraction, with sufficient vis a tergo, would be shown in a stationary venous condition, perhaps livid congestion of the limb; while if the vis and the attraction be both wanting, the limb must be simply cold and inactive—in fact, dying. The integrity of the walls of the anastomosing vessels is also an important condition in the restoration of the collateral circulation.

[2] The number of anastomosing branches varies considerably. Porta (op. cit.) figures a preparation in which he found between fifty and sixty. On the other hand, there is a preparation in the Museum of St. Thomas's Hospital, in which the blood is brought down from the upper to the lower part of the brachial artery by a single branch the size of a crow-quill. Sir Astley Cooper states, probably referring to this preparation, as well as to that of a man whose thigh he amputated some years after an operation for popliteal aneurism, that although the anastomosing vessels which enlarge immediately after the operation may be numerous, their number afterwards diminishes, those less necessary yielding their place, as it were, to a few, or perhaps to a single vessel, which may be found nearly in the place and nearly of the size of the original trunk. (Wardrop, op.

The accompanying representation of a specimen in the Museum of St. George's Hospital, from a case of femoral aneurism, illustrates most of these points, allowance being made for the difference of the arteries involved in the changes.

Fig. 317.



Cure of femoral aneurism by ligature of the external iliac. The artery is seen to be obliterated for some distance at the seat of ligature: *a*, *b b* show the enlarged collaterals on either side of the ligatured portion. The artery is again obliterated for a short distance near the aneurism; *c* points to enlarged collaterals, one of them of very large size, probably the profunda. The artery is seen to resume almost its natural size just below the aneurism. (From a preparation in St. George's Hospital Museum, ser. vi., No. 120.)

The rapidity with which this process goes on cannot well be ascertained in the human subject. In animals it is known to be very rapid;[1] but in animals the process of repair in all injuries of vessels is very far more active than in man, so that in them gangrene never follows on the ligature of arteries. No sound conclusions, therefore, can be drawn from this experience. In man, however, the process seems to advance sometimes very rapidly in the upper extremity, where the natural anastomoses are free. Thus, in Anel's celebrated case, it is stated that the pulse could be felt at the wrist on the day after the ligature of the brachial. In Mayo's case of ligature of the subclavian,[2] the pulse was felt at the wrist on the fifth day but disappeared afterwards; and in a

cit. p. 12; see also Med.-Chir. Trans., vol. xxv., p. 117.) Two beautiful plates, the back and front view of a preparation in which the collateral circulation has been injected after ligature of the femoral, may be seen in Porta's work. The very free communication between the external circumflex, superior external articular, and anastomotica magna, is very clearly shown. There is also a large and direct arch of anastomosis between the latter artery and the internal circumflex. Thus the femoral and popliteal above the aneurism have been kept pervious, while below the aneurism the blood enters the popliteal by two great branches (inferior articular), which receive their supply from a large arterial network in front of the joint, derived from the arteries above mentioned (viz., profunda, anastomotica magna, external circumflex, and superior articular): a direct communication from this network to the tibial recurrent appears also to have reinforced the anterior tibial.

[1] See the experiments of M. Broca (op. cit., p. 507, note). He placed a ligature under the femoral artery of a dog in the groin; then amputated the leg at the knee, and noted the distance to which the pulsating jet extended, both during the systole and diastole of the heart. The ligature in the groin was then tightened, by which, of course, the bleeding was stopped for the time; but it recommenced from the popliteal artery at the end of one minute, and at the end of five minutes the jet (which, however, no longer pulsated) had attained a quarter of its former maximum, even though the quantity of blood in the body was less. In an interesting case reported by Professor Otto Weber in the Deutsche Klinik, 1867, p. 285, he extirpated a tumor from the thigh. The femoral artery was so closely connected to the tumor, that after dissecting it as it went into the tumor above, he tied a ligature on it. He did not divide the artery then, but proceeded to dissect the vessels at the lower part of the tumor. Having exposed them, he placed a single ligature round both the artery and vein, without tightening it. The artery was noticed to pulsate strongly, and when opened, bled almost as fiercely as if it had never been tied. Then the ligature was tied, and the tumor removed with more than two inches of each vessel. The precise time between tying the upper end of the artery and opening the lower is not given, but could not have been many minutes. The patient recovered perfectly. In this case, as Professor Weber remarks, the collateral circulation had been doubtless enlarged by the pressure of the tumor on the main trunk.

[2] Med.-Chir. Trans., vol. xvi., p. 363.

[Fig. 318.

Fig. 319.

Collateral circulation after ligation of the external iliac artery; from a specimen in Guy's Hospital Museum.

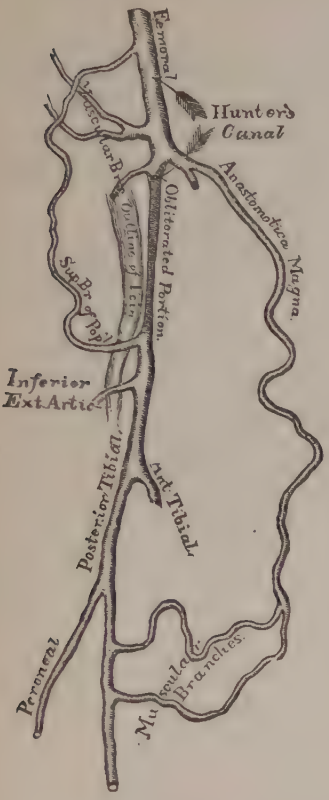
Fig. 318.—Posterior view.—*a*. Gluteal artery. *b*. Ischiatic artery. *c*. Anastomosing branches of the gluteal with the circumflex. *d*. Anastomosing branches of ischiatic with the perforating branches of the profunda.
Fig. 319.—Anterior view.—*a*. Common iliac artery. *b*. External iliac. *c*. Internal iliac. *d*. Femoral. *e*. Profunda. *f*. External circumflex. *g*. Internal circumflex. *h*. Iliac artery, which had been tied and had shriveled into a cord. *i*. Remains of aneurismal sac. *k*. Anastomosing branches of the circumflex ilii. *l*. Anastomosing branches of the circumflexa externa. *m*. Obturator artery, anastomosing with *n*, circumflexa interna.]

case of popliteal aneurism operated on by Deschamps, pulsation was, it is said, felt in the sac seven hours after the operation.[1] On the other hand, in a case where the present writer had occasion to tie the axillary artery during an operation, the patient being a child, no pulse was found perceptible in the radial more than a year afterwards. The enlargement of the collaterals has taken place to some extent before the operation in most, if not all, cases of aneurism, being occasioned by the obstacle to the circulation caused by the aneurismal tumor. The readiness of the return of pulsation will depend in a great measure upon the agents by which the circulation is restored. Thus, if one large branch join the artery below the ligature, the anastomosis being very likely effected principally by a single arch of artery joining this (as in Sir. A. Cooper's case), pulsation will be restored quickly; if a large network of small branches carry on the circulation, it may be absent for an indefinite period. Whatever the period may be, it is certain that in a few days at the latest, either gangrene will set in, or the circulation will be so far re-established that the blood will flow through the artery, entering it by the branch which joins it below the ligature, and probably by many of the successive branches. Thus, when the ligature has

[1] Wardrop remarks on this head: "The enlargement of the anastomosing vessels, to a certain extent, takes place almost instantly after the trunk has been tied. I observed this in a child in whom I had secured the carotid artery. I could see the branches of the temporal and occipital underneath the delicate integument enlarging, and thus actively acquiring great additional vigor immediately after the operation." (On Aneurism, p. 12.) As to the time at which the process is completed, the following is extracted from Porta (op. cit., p. 223): "It is difficult to determine the time of the restoration of the collateral circulation after the ligature, inasmuch as it varies in different cases. Sometimes, after two or three months, the anastomotic circulation is so full, that it seems at the height of its development; while in other cases, six or eight months afterwards (always compared with the healthy limb) it may be said to be hardly matured. From my observations, I am led to believe that the collateral circulation is developed in a limb operated on in the space of a few months, and generally before the end of the first year; because, on analyzing specimens at remoter epochs, after 12, 18, 24, 36 months, it is not found that the anastomotic system has progressed farther. This system is fully constituted at that time when it has attained the aim of its development, and has brought up the circulation to the measure of the requirements of the limb, and so is brought to a standstill."

been applied far away from the disease, the blood returns into the vessel above the aneurism; and so, if the tumor be not already filled with clot, the circulation through it may be re-established.

[Fig. 320.



Collateral circulation after obliteration of the popliteal artery.]

This circulation is sometimes sufficient to prevent coagulation and to perpetuate the disease; and failures from this cause are occasionally, but rarely, noted. More commonly, the force of the circulation is sufficient to cause a sort of undulatory movement to become perceptible in the contents of the tumor a few days after the ligature; but coagulation is advancing, and will rapidly suppress this movement, which soon ceases to be appreciable. Now in these successful cases the anatomical condition of parts may be twofold. If the artery and aneurism form one channel, or if the aneurism stand off like a bud from the artery, the canal of the vessel may be left pervious,[1] and the circulation will be carried on through it. But in the great majority of aneurisms, which are neither fusiform nor pedunculated, but sessile, and involving more or less of the circumference of the vessel, the obliteration of the tumor involves that of the affected artery; and now another arch of anastomoses will often be required. The necessity for the formation of this lower arch of anastomosis will depend on the distance between the point of ligature and the aneurism, and on the number of branches which communicate with the main trunk between them. If the point of ligature be distant, as in the common operation for popliteal aneurism, or if many branches intervene, the artery will be pervious between the ligature and the tumor (Fig. 317), and therefore, two sets of collaterals must be developed; one to carry the blood round the seat of ligature, the other round the aneurism. There is no evidence to prove that this double call upon the powers of nature exercises an unfavorable influence on the prospects of the operation, although it is quite possible that it may do so. [Such evidence seems to be afforded by the frequent occurrence of gangrene after a second ligature has been applied at a higher point in the course of an artery to check secondary hemorrhage; or when a single ligature has been applied to a vessel upon which there are two or more aneurisms, as in the case reported by Mr. Oliver Pemberton in the Lancet, Aug. 4, 1877.] Thus, some of the cases of suppuration in the sac after ligature, such as those quoted on p. 336, may be due to imperfect development of collaterals round the aneurism, and the consequent persistence of the circulation through the tumor, which ought to be temporary only. It is probable, however, that the very fact of the existence of an aneurism exerts in most cases a retarding influence on the circulation through the trunk of the vessel, and thus induces a preliminary expansion of the branches

[1] The latter disposition of parts existed in a case where Sir A. Cooper tied the external iliac. See the account of the dissection in Guy's Hospital Reports, vol. i. I have not met with a case of the former disposition after ligature; but it may be seen after spontaneous cure in Hodgson's case, quoted on p. 334; and after the cure by pressure in a preparation in St. George's Hospital Museum, figured on p. 365. In the first case of ligature of the internal iliac, by Dr. Stevens, the pelvis was brought over to this country for dissection, the patient having survived the operation ten years. The account (by Prof. Owen) of the dissection may be found in Med.-Chir. Trans., vol. xvi., and there it is noticed that the aneurism (which was of the tubular kind) had in the centre a cavity containing only loose coagula; but no circulation had gone on through it.

immediately above it, so that the lower arch of anastomosis may be more easily formed than the upper; or the latter may take the place of both, the collaterals above the ligature communicating with the branches of the artery beyond the aneurism, as would be the case in an aneurism seated on the common carotid, where no branches intervene between the ligature and the tumor, and usually in the external iliac. In most cases, dissection after a successful operation will show the artery obliterated at the seat of ligature and at that of the aneurism, and pervious between them.[1]

The immediate effect of a ligature applied to a main trunk is of course to suspend for the time the supply of blood and the vis a tergo of the heart. Hence congestion of the blood in the extremity, and hence temporary rise of temperature.[2] Another immediate and necessary effect of the ligature is the temporary loss of power in the parts supplied by the obliterated artery. This phenomenon is not so often observed in men, since the conditions of their treatment prevent any attempt at movement of the limb operated on;[3] hence a tingling and numbness is generally all that is complained of; but it can easily be verified on animals. Thus, after ligature of the abdominal aorta in a dog, the animal will be noticed to drag his hind legs just as if he had received a severe injury to the spine. Sometimes in men, although the immediate paralysis may pass unobserved, its effects will persist, and a partial loss of motion in the limb will be permanent. Still more often the nutrition of the part is impaired, so that the member is thinner, colder, and weaker than the other. This I have myself noticed in the case of the child above referred to, in whom the axillary artery had been tied. When she was last seen (more than a year after the operation), the arm, although it was the right, was decidedly smaller and weaker than the other. Thus also gangrene, from accidental exposure to cold, may occur long afterwards in the toes in cases where the femoral artery has been tied, even when no symptom of gangrene has followed immediately on the operation.[1]

[A lad whose femoral and external iliac arteries had been tied, the latter on account of secondary hemorrhage following the first operation, sought admission to Bellevue Hospital every winter for several years, to be treated for small patches of gangrene involving only the skin of the leg, and caused by the cold.]

These unfavorable consequences should not be lost sight of in determining the question of ligature or compression. They depend in all probability on a defective development, either in size or number, of the collaterals, by which the nutrition of the parts is diminished, the conducting property of the nerves probably suspended, and the irritability of the muscles impaired. Mr. Liston thought that the excessive development of anastomosing branches running in the substance of nerves, such as the comes nervi ischiatici, might produce paralysis. This seems improbable, but receives a certain amount of support from a case related by Porta, and from some observations which he has made upon it.[2]

Causes of death after ligature.—The chief dangers following the operation are from gangrene and secondary hemorrhage,[3] excluding the complications to which all operations are exposed, and the special

[1] For a collection of several cases in which the femoral artery was found pervious between the ligature and the aneurism, see Wishart's Scarpa, pp. 263–4.

[2] See Dr. J. R. Wood's case, in "Report of Surgical Practice of Bellevue Hospital," N. Y. Journ. of Med., 1858, p. 239; and Sir W. Lawrence's, in Med. Chir. Trans., vol. vi., p. 206. It will be remarked in the latter case, one of ligature of the external iliac, that though the ham on the affected side was warmer than on the sound side, the foot was always colder. It is interesting to observe that in experiments on animals this rise of temperature does not take place, the activity of the collateral circulation preventing even temporary congestion (see Broca, p. 507).

[3] But sometimes slight and transient paralysis of motion or sensation is observed (see Mr. Chamberlaine's case of ligature of the axillary artery, Med. Chir. Trans., vol. vi., p. 131).

[1] A kind of semi-gangrene is often found in limbs where the main artery has been tied, leading to a low and obstinate form of ulceration. A patient was lately under my care, in whom the femoral artery had been tied in the groin, by Mr. Smyly. Two of the toes had mortified, but the sore had healed, and this would have given him no inconvenience. The whole foot and leg, however, was cold and weak, and the skin prone to a very obstinate ulceration, which rendered it difficult for him to earn his living. I ought to say, however, that he had suffered before the operation from some disease of the skin.

[2] See Porta, op. cit., p. 381.

[3] In the American Journal of the Medical Sciences, new series, vols. x., xiii., xiv., xviii., xl., are some excellent statistical papers upon the ligature of the principal arteries, viz., the subclavian, carotid, femoral, external, internal, and common iliac, showing the proportion and causes of death in each operation. The former papers are from the pen of Dr. Norris; the last is by Dr. Stephen Smith. As they display an amount of mortality after these operations which is probably not gene-

dangers which result in tying individual arteries from their anatomical relations, and which will be discussed in speaking of the special operations. Gangrene is perhaps a more frequent cause of death than hemorrhage after ligature of arteries in the lower extremity.[1] In the upper extremity, the anastomoses are so frequent, that the parts are nearly in the same conditions as in the lower animals, in whom gangrene is, as we have seen, unknown. The causes of gangrene are, a deficiency in number or in extensibility of the collateral branches, or a want of due care in maintaining the temperature of the part after the operation, constricting the limb with bandages, or, finally, some injury done to the principal vein of the limb during the operation.[2] Little can be done

rally known, it may be as well to quote all these statistics together.

Ligature of	No. of cases collected	No. of deaths	Per cent.
Subclavian	69	33	47.8
Carotid	149	54	36.2
Femoral	204	50	24.5
External iliac	118	33	27.9
Internal iliac	7	3	42.8
Common iliac	32	25	78.1
Total	579	198	33.1

Dr. Pilz's and Dr. Cutter's more recent and fuller statistics of the ligature of the carotid and external iliac arteries, which will be referred to hereafter, raise the mortality after those operations still higher.

If the reader will compare these returns with the most complete statistics hitherto obtained of the mortality after other surgical operations, as those of amputation by Mr. Bryant in Med. Chir. Trans., vol. xlii., he will at once see that the ligature of the main artery of a limb involves the gravest dangers, and is an operation that should only be undertaken in the face of evident necessity. The above returns might have been made still more unfavorable by collecting the cases of ligature of the two largest arteries—the aorta and innominate; but it was thought better not to include operations which many persons consider unjustifiable, and which will probably be soon banished from surgical practice.

By comparing Mr. Bryant's statistics of amputation, it will be seen that the ligature even of the femoral artery, the lowest in this list, is almost as fatal as ordinary amputation of the thigh (which appears in those statistics as being fatal in 27.27 per cent. of cases), while most of the others approach the mortality of the greater primary amputations.

These considerations show strongly the propriety of avoiding ligature of a large artery whenever there is any prospect of curing the disease by any other method. The table in Porta's work (p. 404) gives a similar conclusion. It contains a synopsis of 600 cases, and might perhaps have been expected to be somewhat more favorable than the above statistics; as, although it includes 12 cases of ligature of the aorta and innominate (which were uniformly fatal), it also comprises 68 of ligature of the brachial, an operation which is generally successful. Still the deaths are 167, or more than 27 per cent.; nor does it show a much more favorable average in any operation except the ligature of the subclavian and common carotid. The difference, however, between Porta's statistics of these operations and those of Norris depends, I have no doubt, merely on some of the published fatal cases having escaped Porta's investigation. The real averages are probably more unfavorable; fatal cases having remained unpublished. At least this conclusion is supported both by what we know of the nature of published cases, and by the experience of English surgeons in the ligature of arteries, as shown in the statistics of the Medical Times and Gazette, which will be again referred to.

[Mr. Holmes, writing in 1874 (Lancet, Dec. 19, 1874, p. 860), claims that the real averages are now, on the contrary, much more favorable. He collected from the various British Hospitals 337 cases of popliteal or femoral aneurism; of these, 87 were treated by ligature, with only 13 deaths, 14.94 per cent. Of these 13 deaths 3 were caused by secondary hemorrhage, 2, or, perhaps, 3, by gangrene, and 5 by hyperæmia or phlebitis.

The use of the catgut ligature has been followed by still more favorable results. Agnew (Surgery, p. 889, 1878) collected 13 cases with only 1 death, cause not given. Mr. Bryant reported (Chir. Soc. Trans., vol. xi., 1878) 14 personal cases, with secondary hemorrhage, slight and easily controlled, in only 2; and I collected (Am. Journ. Med. Sci., Jan. 7, 1881) 29 cases by New York surgeons, with no secondary hemorrhage and with gangrene (of the foot, followed by recovery) in only 1. See note on page 347.]

[1] Of the fifty fatal cases of ligature of the femoral artery in Norris's table, twenty-three are stated to have died of gangrene, and only eight of hemorrhage.

[2] That gangrene is often due to injury of the vein is an opinion which Mr. Syme has strongly insisted on (Principles of Surgery, 1856, p. 99). He even appears to go so far as to allege this as the only cause of gangrene, discrediting the received opinion (which has just been stated above) entirely. But that gangrene may occur when no injury has been done to the vein is proved by numerous facts. Amongst others, a preparation exists in the Museum of St. George's Hospital, with a record of a careful dissection by the late Mr. Gray, in which the vein was clearly proved to be perfectly healthy and uninjured, yet the patient died of gangrene. The vein has also been known to be included in many operations on the femoral artery without any symptom of gangrene. John Hunter at first purposely tied up the vein, and Roux has confessed to having done so accidentally. Langenbeck (Archiv für kl. Chir., vol. i., pt.

to obviate the first cause of failure. It may be suspected, in persons of weak circulation and exhausted by old age or excess, that in the former case their arteries may possibly not anastomose very freely, while the latter class are nearly sure to labor under an atheromatous condition of the vessels. Hence both are bad subjects for the ligature of an important artery; but as these operations are now never performed unless under circumstances of urgency, in which all risks must be run, a knowledge of the state of the arteries, even if it could be certainly attained, would, after all, only affect prognosis. Much may, however, be done to prevent gangrene by maintaining the temperature of the part. It would seem at first sight inconsistent to talk of the necessity of keeping up the temperature in an extremity in which, as we have seen, it has already risen above the standard of health. But this contradiction is only apparent. The temperature of the toes rises after ligature of the femoral artery, not from increased power in the part, or increased vital activity, in which case it would clearly be wrong to add fuel to the fire, but from diminution of the vis a tergo of the heart, and consequent stagnation of the blood in the extreme vessels. Expose the part to cold—the tissues will contract upon and unload the vessels, which will themselves also be constricted by the cold—and the part will not only be deprived of blood, but a powerful obstacle will be offered to the weakened circulation by the rigid and contracted state of the vessels and the parts which support them; an obstacle which most probably will be found insurmountable. Hence the importance of maintaining the limb as near the natural temperature of the body as possible. It should not be much warmer, since parts in which the circulation is imperfect are as little able to resist heat as cold: thus gangrene has followed the application of hot salt or sand-bags to the limb. The best application is carded wool, which merely retains the natural warmth, and has the additional merit of retaining it without requiring renewal, while it allows the occasional inspection of the limb if required. It is advisable, however, to make such inspection only rarely, since it cannot be done without some change of temperature, which, if often repeated, might have a prejudicial effect. The wool should be used in large quantity, so as to form a thick layer around the whole limb, nearly as high as the seat of operation, and secured by a bandage loosely twisted round. It will be understood that the limb should be kept in such a position as to facilitate the return of blood.[1]

The patient's diet and regimen should not be too rigid. This will of course be regulated by his previous habits; and the same may be said of the exhibition of opium. In persons of dissipated lives and nervous temperaments, stimulants and moderate quantities of opium must be allowed; while robust persons, with equable and tolerably strong pulse (who, however, are rarely the subjects of aneurism), will do better on a nourishing but unstimulating diet.

When gangrene has once declared itself, which usually occurs on the second to the fourth day,[2] the case becomes grave; but the prognosis is not hopeless.[3] All depends on the rapidity with which the mortification advances. If, as is sometimes the case, it shows itself, not merely in the ends of the toes, but simultaneously on the dorsum of the foot, and advances with rapidity, no time should be lost in amputating, and the limb should be removed as near the seat of ligature as may be found convenient. It is not absolutely necessary to operate at, or above, the place where the artery has been tied. The portion of the limb just below this spot is nourished, not from the obliterated part of the vessel, but by the branches of a higher origin, so that there is no fear of sloughing of the stump.

When the gangrene, on the contrary, appears only in a limited space, and extends slowly in the continuity of the limb, hope may rationally be entertained of preserving the member. The case must be treated like any other case of gangrene, by local warmth, local and general stimu-

1) and Gibson (Am. Journ. of Med. Sc., vol. xiii., p. 305) have both tied the internal jugular vein and carotid artery in extirpating tumors, Cooper of San Francisco (New York Journ. of Med., 1857, vol. iii., ser. iii., p. 410) the external iliac vein and artery in a case of aneurism, with good results. The *partial* ligature of the vein, in which the thread is left like a seton in the cavity of the vessel, is much more likely to be followed by fatal effects. Mr. Carmichael and others have spoken of the occurrence of phlebitis and obliteration of the vein, sometimes followed by gangrene, as a consequence of injury to the vein (see Broca, p. 479).

[1] Mr. Guthrie's favorite method for obviating gangrene was to have the limb constantly chafed by the attendants.

[2] Although sometimes not till the second or third week (Porta, op. cit., p. 393). In Dr. Hargrave's case of ligature of the common iliac artery (Dublin, 1865), gangrene did not show itself till the thirty-first day, and was hardly stopped when the patient died on the seventy-third day.

[3] The mortality of gangrene after ligature of the femoral artery is estimated by Porta at 71 per cent.

lants, and opium, with due regard to the patient's constitution, nervous temperament, and general symptoms. I venture to think that the attempt to preserve limbs after gangrene the result of ligature is not, generally speaking, carried far enough. The prognosis of amputation in these circumstances is not very favorable; the cases closely resembling those of secondary amputation—the most fatal, according to Mr. Bryant,[1] of all classes of amputation.[2] Suppuration and sloughing of the sac is a kind of gangrene, and is one of the chief causes of death after ligature. It sometimes gives rise to hemorrhage; but more frequently it poisons the blood, and leads to death either by pyæmia, or by that systemic infection of which pyæmia is the local manifestation.

The other cause of death, that from secondary hemorrhage, has been already treated of in the essay on INJURIES OF THE VESSELS, vol. i., p. 463.[3] It is more common in the upper extremity, where the heart is near, the circulation powerful, and the processes more rapid, than in the lower. It is also more to be apprehended after ligature for aneurism, when the artery is more likely to be diseased at the point operated on, than for wound, when it will, in all probability, be healthy.

Besides these causes of death after ligature, the operation sometimes fails to cure the aneurism, though the patient survives. This, indeed, is rare; but it seems to occur in two ways. Either the pulsation never disappears in the tumor, and the latter, perhaps after a temporary check, continues growing in size, and will ultimately burst; or the aneurism diminishes, becomes solid and undergoes a process of apparent cure, but then, after a longer or shorter period of quiescence, the pulsation reappears, sometimes with a sudden increase in size, and the disease is said to recur.

When the ligature fails to abolish the pulsation, this depends again on one of two causes. The artery may have connected with it a "vas aberrans," by which the blood is brought directly down into the tumor. Such was the state of parts in Sir C. Bell's case of ligature of the femoral artery.[4] This condition of the vessels, however, will not escape the attention of a careful and well-instructed operator; and the fact that tightening the ligature has not its usual effect on the pulsation of the aneurism, will show that the latter must either be seated on some other vessel, or, at any rate, must communicate as freely with another vessel as with the one tied. Accordingly this other vessel must be sought for by careful dissection; and until it is found the original ligature is not to be tightened. If there be a vas aberrans, the other vessel will be at no great distance, and should be tied at once. When this has been done, if pulsation is quite abolished in the aneurism, it will perhaps be unnecessary to tie the vessel first exposed; but it will be more prudent to leave the ligature (which has been already passed) under it, to be tied on the first symptom of returning pulsation in the tumor. These anatomical anomalies are so rare as to be merely surgical curiosities; still they should be borne in mind. It more frequently occurs that the circulation through the aneurism, temporarily abolished by the ligature, returns in a few hours or days, and continues to increase till it reaches its previous force, and the disease runs its course apparently unaffected by the operation.[1] This accident must be due to the preternatural activity of the

[1] Med.-Chir. Trans., vol. xlii.

[2] Of forty-nine cases of gangrene after ligature, fourteen recovered; ten of these without, and only four after, amputation (Porta, op. cit., p. 394).

[3] See also the sections on ligature of individual arteries.

[4] London Medical and Physical Journal, vol. lvi., p. 134.

[1] The *temporary* return of pulsation is not so uncommon. Porta remarks on this head: "Out of 448 cases of aneurism and aneurismal varix cured by the Hunterian operation, there was in twenty-five cases a relapse; that is to say, a manifest reappearance of pulsation in the tumor; but the pulsation was temporary, lasting from a few weeks to some months, and then disappearing. The case, however, above related of Miloni, and the two published cases under the care of Cooper and Roux, show that even in the thigh the anastomosis may enlarge to such a point as to annul the action of the ligature. Such cases are fortunately most rare. Relapse would occur much more frequently in the neck and elbow, where the anastomoses are naturally so ample and direct, were it not that the aneurism, however small, already contains some clot; and the blood, directly on the application of the ligature, being reduced for some days to the minimum of movement in the trunk operated on, ceases during that time to feed the tumor and the aneurismal artery, so allowing the obliteration of both by fresh clot" (op. cit., p. 385). The three cases referred to will be found in Porta, p. p. 378; Brit. and For. Med.-Chir. Rev., vol. vi., p 67; Bolletino di Bologna, an. xiii., series 2, vol. xi., p. 185. Another case, which illustrates the return of circulation after ligature, occurred in Mr. Stanley's practice. He tied the posterior tibial artery low down in the leg for wound, using two ligatures at some distance from the opening. Hemorrhage continued; and he had to place other threads closer to the hole in the artery (Ormerod, Clinical Collections, p. 151).

collateral circulation; and it is one which it is difficult to meet with appropriate treatment. In the first place, it seems reasonable that nothing should be done until the limb appears beyond the risk of gangrene, and until the pulsation is plainly permanent; and this cannot be said to be the case until the tumor has been pulsating very distinctly for some months, and the pulsation shows no tendency to abate. It should always be borne in mind that a slight undulatory pulsation in an aneurism on the second or third day after ligature is a very usual phenomenon, and so far from being of evil augury, is considered by many authors to be a favorable sign, rendering it more probable that laminated clot will form. It is assumed that, previous to the original operation, compression of the artery above the tumor has either been tried and failed, or was contra-indicated. Hence it will be probably useless to recur to that method. Direct pressure, or genuflexion, or forcible flexion of the elbow if the aneurism be in the forearm, with appropriate bandaging of the limb, will of course be tried. When these measures fail, two courses are open—either to tie the artery lower down, between the ligature and the aneurism, or to perform the old operation of opening the sac and tying the artery as it enters and leaves it. As a general rule, the former method will be preferable in the lower extremity, the latter in the upper. [Mr. Annandale's and Dr. Hutchison's cases (page 341) show that the old operation of opening the sac can be successfully employed also in the lower extremity.] Or if the surgeon has sufficient confidence in such measures, he may resort to galvano-puncture, or to the injection of perchloride of iron (see below, the sections which treat of these methods of curing aneurism). The ligature of the main trunk above the original seat of operation has been tried, but it appears to be contra-indicated both by theory and practice.[1]

The recurrence of aneurism is, however, usually observed at a later period, after the persistence of the apparent cure for weeks or months. This was the case with a patient of Mr. Spence, of Edinburgh, in whom the aneurism was afterwards cured by genuflexion. The case will be found quoted lower down. It does not appear that the cure was ever a sound one after the ligature; and the pulsation in the aneurism was never abolished, though on the patient's first discharge it had been reduced to a line which was thought not to be more extensive than that of the popliteal on the other side. Cases such as this fail from the faulty formation of the clot. The sac is filled, not with laminated coagulum, but in part, at least, with mere soft clots; and these clots in the course of time soften and yield to the force of the circulation, or pass into its current. When this is the case, the affair becomes even more grave than when the disease recurs from the causes mentioned in the last paragraph, since the too rapid development of the collaterals is, after all, rather a phenomenon of over vitality than otherwise; while, on the contrary, this indisposition of the blood to form laminated coagula under the usual conditions, appears to testify to some profound alteration in the vital fluid itself. The prognosis, therefore, will be worse than in the latter case; but the treatment must be the same, since no more radical measures are at hand except amputation; and to this no judicious surgeon will have recourse until he is clearly certain that no other course is open. When, however, the ligature has certainly failed, and the case seems otherwise hopeless, no good can be expected from delaying amputation.

[Mr. Annandale's second case (p. 341) is an instance of another cause of recurrence, viz., rupture of the sac after it has shrunk and become apparently cured.]

Such are the causes of failure, and the methods, at the best very uncertain of success, by which they may be met. But in the great majority of cases in which the patient survives the operation, matters progress quite otherwise. The ligature, after a certain length of time (which varies, generally between about ten days and a month, according to the size of the vessel, the neatness with which it has been separated from contiguous parts, and the rapidity of vital changes in the patient operated on), cuts through the artery, and comes away with the discharge. The wound then heals, the divided ends of the artery reunite, and the whole of the obliterated portion of the vessel degenerates into a fibrous cord. The tumor, at the same time, consolidates more or less rapidly; the undulating movement, which was perceptible in it at first, disappearing as the deposition of laminated coagulum advances, until at length the whole is consolidated, and then begins to shrink. Finally, as after the spontaneous cure, a small hard tumor remains, like a walnut, which, if cut into, displays a structure something like that of an onion. With the exception of the obliteration of the artery at these two points (for the persistence of circulation through or past the aneurism is rare), and

[1] As to the three cases mentioned in the previous note: in Sir Astley Cooper's case the artery was tied close above the sac successfully; in Porta's case the external iliac was tied, but the patient died of the operation; in Roux's case no treatment seems to have been adopted.

the consequent development of collaterals, everything in the limb is natural. In other cases, the weakness and faults of nutrition, which always attend at first upon the ligature of the main trunk of a limb, persist, and occasion atrophy of the muscles, fatty degeneration, etc.

Having discussed the mode of action and the effects of a ligature applied to the main artery of the limb above the sac of an aneurism, as Hunter directed, it is perhaps necessary for me to express an opinion as to the cases in which this plan is indicated. The best formulæ, I think, would be as follows :—

1. It is indicated whenever the aneurism (which must always be supposed to be in an active condition, and advancing, or threatening to advance) is situated upon an artery inaccessible to pressure, but which will allow a ligature to be put round it without excessive danger, and with a sufficient space between the part tied and the tumor. Of these conditions the iliac and carotid arteries furnish the best examples.

2. When in an aneurism differently situated, the patient, from nervous irritability, drunkenness, or any other cause, is intolerant of more gradual methods, such as pressure, genuflexion, etc.[1]

3. When these methods have been tried and failed.

4. When an aneurism has burst into one of the internal cavities of the body, *e. g.*, a popliteal aneurism into the knee-joint.

For a very interesting example of cure by ligature of the femoral, even after this formidable complication, the reader is referred to a case which occurred at the Middlesex Hospital, under the care of Mr. Moore, and which will be found reported in the British Medical Journal, 1859, p. 489.

5. When the rupture has taken place subcutaneously, amputation or the ligature is generally indicated ; still, in some of the less grave cases, it may be possible to obtain a cure by compression, but the attempt should not be too long persisted in ; while, if the symptoms are urgent, or if gangrene have commenced, amputation is the only resource.[2]

Internal aneurism does not absolutely contra-indicate the operation, although it is a most powerful motive for avoiding it unless it is believed necessary for the immediate preservation of life. Dr. Crisp (op. cit., p. 189) says that several cases are recorded where persons with aneurism of the thoracic aorta have survived the operation. But, in one celebrated case, the patient died on the table, from rupture of an internal aneurism, just as the operation was being begun. This accident would now probably have been avoided by the quietness and absence of agitation produced by anæsthesia.

Contra-indications to ligature.—The late Mr. Aston Key has declared that, in his opinion, "the only circumstance that ought to deter a surgeon from putting a ligature around any artery in the human body (not excepting the aorta) is, the uniform cessation of circulation in the parts below the ligature."[1] But if we regard the preservation of the patient's life as the ultimate end of all operations, we must surely allow that any proceeding which is uniformly followed by death is unjustifiable, by whatever cause or causes death may have been produced; and, still more clearly so, if the disease for which the operation has been undertaken has been known to be cured by other means. To both these objections the operations for securing the aorta and innominate artery are fairly liable. On the first head, it may indeed be urged that the number of cases of ligature is as yet insufficient to allow of our asserting that these operations are uniformly fatal. This is a point which must be left to the judgment of those who may be called upon to decide on the treatment of a case of this nature ; but on the second head there is no doubt. Aneurisms at the root of the neck and in the belly have often yielded

[1] Such intolerance must not, however, be too hastily admitted. Almost every person of ordinary good sense, and even of less than ordinary resolution, may be educated, by the gradual and transient use of digital pressure first, and the pressure of instruments afterwards, to bear the amount and duration of compression which is requisite.

[2] The subject of rupture of aneurism has been referred to above (p. 323). A paper by Samuel Cooper in the Med.-Chir. Trans., vol. xvi., will repay perusal. He points out that the pain is not always severe, that the shape of the tumor may be not much altered, and that, beyond a little purple discoloration, no trace of ecchymosis may be noticed. In these cases he is inclined to lay great stress upon the persistence of bruit, combined with the absence or gradual disappearance of pulsation, and a sudden fall in the temperature of the limb. Mr. Poland's paper, in Guy's Hospital Reports, 3d series, vol. vi., contains notes of 42 cases in which the sac of a popliteal aneurism burst, and of the result of the treatment. In 2 no treatment was adopted ; in 1 of these the tumor burst externally, but the patient survived the bleeding and recovered. In 24 compression was used, which succeeded in 2 cases. In 16 the femoral artery was tied : 10 recovered without, and 2 after, amputation ; 4 died—3 of gangrene, 1 after amputation on account of suppuration of the sac.

[1] Med.-Chir. Trans., vol. xiii., p. 8.

to medical treatment or undergone spontaneous cure, while they have as yet never been cured by operation, except in one instance of traumatic aneurism, for which the innominate was tied. So that, if ligature be used at all in these aneurisms, it should only be as a last resort, when they have burst or are on the point of bursting, or when they are increasing under the best medical treatment which can be procured.[1] [This opinion apparently is not intended to include the treatment of aneurism at the root of the neck by distal ligature. Mr. Holmes, Mr. Heath, and others have recently relieved aneurism of the arch of the aorta by tying the left carotid, and in several cases the treatment of supposed aneurism of the innominate by ligature of the carotid or subclavian, or of both, has been followed by cure or by marked relief of symptoms. See p. 421.] Again, the ligature should never be applied to any artery which is so situated as to admit of compression, unless that treatment has been tried and failed, or is contra-indicated by some peculiarity in the case. Nor should the ligature be used in cases of recent traumatic aneurism, particularly when caused by fracture, without a previous trial of the resources of nature, aided by such means as rest, position, careful bandaging, and pressure direct and indirect. Such cases, as we shall see, are peculiarly likely to undergo spontaneous cure. Nor should the ligature be used if the heart or a great part of the arterial system is diseased. In such cases digital compression is the most appropriate and safest treatment.

Acupressure and Temporary Ligature.

This seems the most appropriate place to notice the proposals which have been made to treat aneurism by the temporary application of compression to the trunk of the vessel affected. These proposals, it is true, have not hitherto come to much; but since Sir J. Simpson's suggestion of acupressure has been so generally adopted, compression of the trunk in this way has occasionally been successful, and this has led to a revival in other forms of the temporary ligature, which proved unsuccessful in the hands of Scarpa, Clive, Sir P. Crampton, and the other surgeons mentioned by Mr. South (Trans. of Chelius's System of Surgery, vol. ii., pp. 218, 222).

A successful instance of the application of acupressure to the cure of a small traumatic aneurism in the ham (probably formed on one of the sural arteries) is referred to by Mr. H. Lee, in the St. George's Hospital Reports, vol. iii., p. 33. Dr. Cheever has recorded in the Boston Med. Journ., Oct. 17, 1867, a case in which he applied acupressure successfully to the femoral artery in popliteal aneurism; but the case was not cured in any shorter time than it would have been by ligature, and the patient seems to have run just as much risk —the artery having been freely exposed, and apparently somewhat roughly handled.

Prof. Porter treated a case of subclavian aneurism unsuccessfully by acupressure of the axillary on the distal side of the tumor. The man died not very long afterwards, and the vessel was found not completely occluded, but narrowed. (Dublin Quarterly Journal, Nov. 1867.)

Numerous contrivances for the temporary occlusion of divided or exposed arteries have been introduced.

One of the neatest appears to be that recommended by Dr. G. H. Porter,[1] which bears some resemblance to an instrument devised by Sir P. Crampton and described in the passage of South's *Chelius*, above referred to, except that the agent of compression is silver wire. This is passed under the artery with an aneurism-needle, and is attached to a small frame made of bent wire, and provided with a ring. The wire is drawn through the ring tight enough to stop the circulation, and is then fixed by twisting it round the ring. When the desired effect has been produced, it can be at once removed.[2]

[Prof. Porter compressed the innominate for three days with an instrument which Mr. Holmes (Lecture, in Lancet, Nov. 16, 1872, p. 699) describes as resembling a small lithotrite. The patient died of hemorrhage from the vessel at the compressed point on

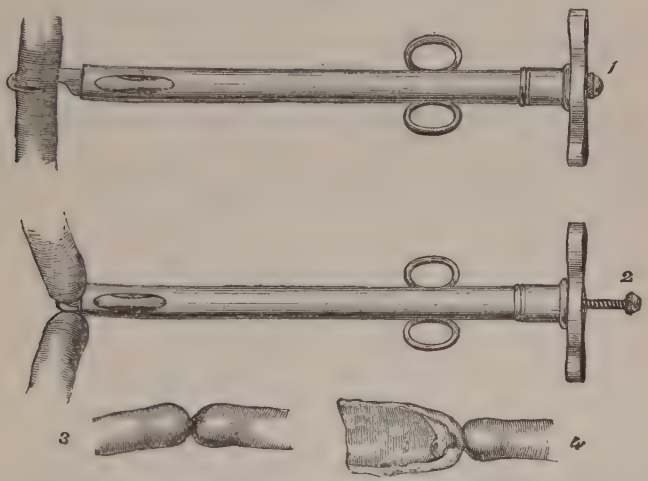
[1] In such a case as the one in which Sir A. Cooper tied the aorta, viz., when the aneurism had opened externally, we may allow that the operation was the only conceivable means of giving the patient a chance for his life, and was equally creditable to the boldness and dexterity of the surgeon. If it be objected that the rules laid down in the text would prevent operations in the root of the neck altogether, since, unless the artery is tied early, it will be out of reach—I would reply, that this argument would show the ligature of the innominate to be an unjustifiable proceeding; for in an early stage of aneurism at the root of the neck, the patient has some chance of spontaneous cure, and a good chance of surviving a tolerably long period, while after the operation his life will, in all probability, be reckoned by hours.

[1] Dublin Quarterly Journal, 1868. This instrument was used for temporary deligation of the abdominal aorta by Dr. W. Stokes, Jun. See the same Journal for Aug., 1869.

[2] For other methods of making temporary compression on exposed arteries, see the authorities quoted in the Biennial Retrospect of the New Syd. Soc., 1867–8, p. 214.

the tenth day. With a modified form of the same instrument, Mr. Robert Perssé White (Dublin Med. Press, Nov. 24, 1875; quoted by Prof. Van Buren in his Report on Aneurism in Trans. Internat. Med. Congress, Phila., 1876) compressed the external iliac for 162 hours, and cured an inguinal aneurism. In Mr. Stokes's case, referred to in the note to the preceding paragraph, Mr. Holmes says the aorta was so firmly closed after pressure with Prof. Porter's instrument for a few hours that water could not be forced through it after death. The patient died of peritonitis. Mr. Bickersteth (Holmes, loc. cit.) compressed the innominate by means of a lead wire drawn loosely around it; the impulse of the blood caused the wire to break on the second day. A ligature was then applied, and the patient died of hemorrhage on the sixth day. Mr. McGill, of Leeds (Med.-Chirurg. Trans., vol. lviii., 1875, p. 337) compressed the first portion of the left subclavian with torsion forceps. At the expiration of 9½ hours the tumor—an aneurism of the third part of the subclavian, was solid and pulseless, and the instrument was removed. The pleural cavity had been accidentally opened in the course of the operation, and the patient died on the sixth day in consequence. The aneurism was found filled with a firm clot, and the artery was patent and uninjured at the point of compression. Mr. Dix (British Med. Journal, Oct. 30, 1875, p. 551) cured an aneurism of the carotid and another of the femoral by passing a wire under the vessel, bringing both ends out through the tissues beside the wound and twisting them over a piece of

Fig. 321.



Dr. Speir's artery constrictor. 1. An artery taken up by the constrictor. 2. Artery constricted. 3. Effects of constriction upon vessel. 4. As seen when laid open.

cork tightly enough to almost arrest pulsation. The incision was then closed for primary union. The wire was tightened on the third day, and removed on the fifth or sixth. Dr. B. Howard (Trans. Am. Med. Assoc., 1870, p. 501) recommended a ligature of silver wire drawn tightly enough almost to arrest pulsation, both ends to be cut short, and the wound closed. Mr. Holmes used the silver ligature in this manner successfully in a case of femoral aneurism, but speaks doubtfully of its safety, and a perusal of Howard's experiments does not inspire confidence in it. Dix's method seems to be preferable. Dr. S. Fleet Speir, of Brooklyn (N. Y. Med. Record, 1873, p. 102) has successfully used, in several amputations, and at least once upon the carotid in continuity, a so-called "artery constrictor" (fig. 321) of his own invention, by means of which the inner and middle coats of the vessel are divided and curled in, while the outer one is left unbroken. The instrument is immediately removed and the wound closed.]

Further experience, however, is necessary to show whether these plans have any real superiority over the ligature used in the ordinary way.

[Prof. Van Buren (loc. cit.) expressed the opinion that, if the carbolized catgut ligature should prove unreliable, Speir's constrictor and the use of silver wire "hold out the best remaining promise of occluding an artery without dividing its coats." No further experience with either of these two methods has been published, so far as I know, while testimony has accumulated rapidly in favor of catgut. The preference, therefore, must still be given to the latter, and it seems to be justified theoretically as well as clinically, for its presence is tolerated even better than that of silver, and the constrictor has been used too rarely upon vessels in continuity to make us willing to dispense with the support given by the catgut to the divided coats of the artery during the first few days. Practically, the "constrictor" seems to be a mod-

ification of the temporary silk ligature, and it does not appear that its action upon the vessel differs materially from that of the other, or that the invagination of the inner and middle coats produced by it could always *be depended* upon to prevent hemorrhage from a large artery. Mr. Bryant says of it (Practice of Surgery, 3d Am. ed., p. 327): "I have tested this instrument on the living, and have made a large number of experiments on the dead, and find it does all that Dr. Speir asserts. I believe it to be of value for obstructing arteries in continuity, as it does for such precisely what torsion does for divided vessels." I notice, however, that he still uses the ligature.]

Brasdor's operation will be discussed along with the treatment of aneurism in the neck, where it is chiefly, if not solely, employed.

Treatment by Instrumental Compression.

The treatment of aneurism by compression is a practice of almost as old a date as that by ligature;[1] but, like it, had fallen out of use from certain imperfections in its details, until it was taken up again, improved, and fitted for practical use by modern surgeons. The old treatment consisted in the application of continuous pressure either to the sac, to the artery above it, or to both; and the cause of its frequent failure, or rather of the great rarity of its success in the hands of the ancient surgeons, arose from their ignorance of the natural process, as we have above attempted to describe it, which effects the cure of aneurisms. Not being aware that the deposition of laminated clot, when once begun, would go on, under favorable circumstances, to the entire obliteration of the sac in almost every case, and that, for the commencement of that coagulation, only a moderate check to the circulation would suffice, they always aimed at suppressing the circulation through the aneurism altogether,[2] and if possible bringing the sides of the sac into contact. It was therefore necessary, in their opinion, to use such an amount of pressure as could hardly be tolerated by any one of ordinary sensitiveness, and which, even if borne by the patient, was pretty sure to produce sloughing. It was from a similar ignorance of the curative powers of nature, and of the ease with which the nice balance between the force of the circulation and the reaction of the arterial walls may be restored, that the Hunterian operation, which had been recommended by the Greek and Arabian writers (whether practised or not, is another question), fell out of notice till that great surgeon re-invented it. Thus, in reading accounts of Guattani's cases, and of others in which the old surgeons attempted to cure aneurism by compression, we are at once struck by the fact, that the pressure was always either too severe or applied to the wrong part, and often both. For as they thought that the principal point was to exclude the blood from the sac, of course the chief means of doing so was to empty the sac by direct pressure. When this was impossible, the next thing was to compress the artery above so firmly that no blood could pass. The modern system of gradual and partial compression[1] is entirely different in principle, and is a strict imitation of the process of spontaneous cure. We have seen that when an aneurism is cured spontaneously, it is in consequence of the circulation having received some partial check, by which laminated coagulum is deposited within the sac. Just so in the cure of aneurism by this method of compression. It is merely necessary to lessen the force of the circulation through the aneurism during some considerable part of each day, and then usually in a few days, but sometimes not till the end of several weeks, it will be noticed that the œdema and venous congestion have quickly subsided, and that pulsation is dimin-

[1] Heister is said to have been the earliest author who recommended pressure in the cure of aneurism, and Guattani the first surgeon who used it with success; but this was direct pressure. See Bellingham, On Aneurism.

[2] It may be interesting to recall Hunter's case: "The aneurism was in the femoral artery, and the swelling appeared upon the anterior part of the thigh, a little above the middle, extending upwards nearly to Poupart's ligament. An attempt was made, by compressing the artery above the tumor by means of an instrument somewhat resembling a steel truss, to give the blood in the sac a chance of coagulating, and by that means put a stop to the progress of the disease. But, from the pain which it occasioned, every attempt to make a permanent compression on the artery proved ineffectual." He then proceeds to describe the progress of the case, the aneurism undergoing a spontaneous cure. (Hunter's Works, vol. iii., p. 602.) The pressure appears to have been applied too strongly, too constantly, and too much in one place. Yet Hunter was fully aware that the cure of aneurism was quite compatible with the persistence of circulation. Much more would surgeons who thought it necessary altogether to abolish the circulation fall into such errors.

[1] The other and still more modern method of total compression during a few hours under chloroform [or ether] will be spoken of afterwards. It was of course impracticable before the introduction of anæsthetics.

ishing in the tumor, that its contents are more solid (which may be known by its varying less in size according as the blood is shut off or let in from the artery when the finger is pressed on it), and that the anastomosing branches are increasing so as to be felt pulsating. When these signs are present, we may be pretty sure that the cure of the aneurism is not far distant.

It would be wrong to pass over in silence the history of this method, although the length to which this essay necessarily extends prevents me from saying more than a very few words on the part played by the Irish surgeons in introducing the treatment of aneurism by compression, and on the gratifying success which has attended that treatment.

It has been noticed above that Hunter treated a case of femoral aneurism by compression on the artery between the tumor and the heart (indirect pressure); and the same plan was adopted by Sir W. Blizard,[1] and is strongly advocated by Mr. Freer;[2] but the latter surgeon, and probably all who preceded those of the Irish school, unless Hunter be an exception, thought that pressure was to act by obliterating the artery. The pain was very great, in consequence of the assumed necessity of making very firm pressure always in the same spot; nevertheless, some few cures were obtained under the care of Pelletan (or Echard), Dubois, Dupuytren, Boyer, and Albers, and are quoted in Dr. Bellingham's work; but these cases of success were balanced by failures, which, according to Dr. Bellingham, were "still more numerous;" and the treatment was so painful and so uncertain that it seemed likely to fall into complete discredit, until Mr. Todd, of Dublin, recommended the use of the plan as an adjuvant to the Hunterian operation; his object being, by preliminary pressure on the trunk of the femoral, to cause the dilatation of the collateral branches, and so to lessen the risk of gangrene. For this purpose he made use of the instrument originally invented by Heister; but no striking results followed from this practice,[3] which was adopted by some surgeons in Dublin and decried by others, but regarded by all merely as an accessory to the ligature, until the accidental success of pressure applied in the case of a patient of Dr. Hutton's (Oct. 3, 1842), who refused to submit to the operation, shortly followed by similar success on a patient of Mr. Cusack's, whose health appeared too broken to enable him to survive the ligature, led to a better appreciation of the matter; and the striking success obtained in a patient of Dr. Bellingham's, the aneurism being cured in two days, drew the attention of surgeons in other countries to the matter, and successful cases followed, not only at Dublin, but also at University College Hospital under Mr. Liston's care, and in other parts of the kingdom. Still the great majority of the cases were treated in Ireland; and it is to the Irish surgeons, and especially to Dr. Bellingham, that the profession is indebted for the true theory of this method of cure. Their success in the application of the treatment has also been much greater than has been obtained in London. In Dr. Bellingham's small but very valuable work on Aneurism[1] (from which the above particulars are extracted) may be found short notes of twenty-five cases (most of them treated in Ireland), in which compression was used, and which included all that had been reported up to that date. In only one of these was it found necessary to resort to ligature of the artery, and then not on account of the failure of the method, but in obedience to the wishes of the patient, who seems to have got tired of the treatment, though it appeared on the point of succeeding. (See also Tufnell's work.)

The experience of English surgeons has been far less favorable. In the Medical Times, vol. ii., 1856, and vol. i., 1860, are to be found some valuable statistics of the cases which have been under treatment during late years in the metropolitan and provincial hospitals. Of the seventy cases included in the first report, which is believed by the reporter, Mr. Hutchinson, to be statistically accurate, as containing all the cases which had been under treatment, forty-six were popliteal aneurisms, treated by pressure. The treatment succeeded in twenty-four of them. Of the remaining twenty-two, in whom the femoral artery was tied, two only died of gangrene; while of ten cases in which the artery was tied without preliminary compression, three died of gangrene. The period of treatment in the successful cases varied from sixty hours to eight months, nineteen days being the average time. The large proportion of cases in which pressure failed will strike the reader. It is probable that it was due to the novelty of the method; since in the second report, which contains fifty-nine cases, treated either by ligature or compression, the latter plan succeeded in twenty-five cases out of thirty-nine. Even this, however, shows a far less striking success than was at first augured for the method, and might have been expected from the experience of Irish surgeons. It is possible that a greater proportion of cures may be obtained as surgeons become more acquainted with the method, and more alive to the necessity of attending to its minuter details. Meanwhile we may agree with Mr. Hutchinson's remark upon the above report, that all the success obtained by compression is clear and unbalanced gain; that in the cases which succeed, the patient is, with no

[1] Bellingham, op. cit., p. 28.

[2] On Aneurism, p. 94 et seq.

[3] It is said, however, to have effected a cure in one unpublished case. (Tufnell, On the Treatment of Aneurism by Compression, p. 27.)

[1] Observations on Aneurism and its Treatment by Compression. Dublin, 1847. I exclude two cases in which galvanism was also used, and one of which proved fatal.

appreciable danger to his life, withdrawn from the very serious risk of the Hunterian operation, and in most of those that fail the dangers of that operation are diminished.

[Mr. Holmes has since shown that this opinion is erroneous. He says (Lancet, Dec. 12, 1874, p. 827), "the larger experience contained in my table of hospital cases leads to precisely the opposite conclusion, and it is that which seems more consistent with *à priori* probability. . . . I must admit that the evidence up to the present time leads to the conclusion that a patient is not more, but less likely to recover from ligature of the femoral if a prolonged application of pressure has previously been made." He is unwilling to say for what length of time the attempt to compress should be continued, but thinks it should not be more than a week.]

The instruments required for the compression treatment are, one or two compressors, and a weight encased in leather. I shall describe the method as applied to the cure of popliteal aneurism; if the brachial or subclavian were the subject of compression, the modifications would be easily made. The compressors now in use are made on the principle of exerting pressure upon a small space, without any circular constriction of the limb. They consist of a plate or trough, which is applied to the lower surface of the thigh at the point opposite to the artery, and a pad supported on this plate by a strong lever or arm, and movable in all directions. The lever stands well away from the thigh, and the instrument is kept in position by the compression which it exercises. When applied, it is screwed down upon the artery until the sensation communicated by the aneurism to the hand is considerably lessened, say diminished about one-half; and is left so until the patient is sensible of inconvenience from it. It is by no means necessary to stop pulsation in the sac altogether, nay, it is not clear that this expedites the cure, unless it can be maintained long enough to cure the disease at once—but for this purpose prolonged anæsthesia is usually required. Patients of quiet temperament and rather blunt sensibility can often tolerate for a time the degree of pressure necessary to stop the circulation; but it will generally be found that even in them it produces injurious consequences, either because the pressure acts on the vein as well as the artery and so causes œdema of the foot, or because the nerves become involved, or perhaps because the sac (which of course shrinks when most of the blood has passed out of it) becomes too violently distended on the withdrawal of the pressure, and so the process of coagulation is interrupted. It is better, then, to commence with very mild pressure, to change the place of its application frequently, and to give the patient such intervals of complete repose as may refresh his spirits and procure him good sleep. The management of the compressor should be intrusted to some one who knows the course of the artery, and can judge of the direction in which pressure should be applied so as to command it. The course of the artery can be indicated by a line drawn down the limb with caustic, and any intelligent person or nurse soon learns where to apply the pad; but the application of pressure in the right direction is more difficult.[1] When the patient has got tired of the sensation caused by the pad of the compressor, he can lay the weight upon the femoral artery in the groin, raising it for a few minutes occasionally; or very often the patient prefers stopping the pulse by the pressure of the finger, thus combining digital with instrumental compression.

The general treatment during compression is a point on which some variety of opinion exists. Some surgeons, even in the present day, when stimulation is so much in vogue, prefer to adopt the depleting plan, although not to the extent recommended and practised by Valsalva; but the majority consider that the advantages, if any, derivable from this course, do not equal the difficulties which the restlessness, discomfort, and distress it occasions to the patient, throw in the way of the treatment. I have seen the depleting plan tried once, but it seemed quite inefficient, and the case was the most protracted cure by compression which I ever heard of; while, on the other hand, a sufficient diet with a mode-

[1] Want of space forbids a complete account of the various kinds of compressors which have been invented for the treatment of popliteal and other forms of aneurism. Perhaps the best form, as obtaining the requisite degree of pressure with the least danger of producing a slough, and being, at the same time, least liable to slip, is Dr. Carte's apparatus, in which the arm carrying the pad is attached to the lever by means of India-rubber bands, and is movable in all directions on a ball-and-socket joint. It is very desirable, however, to have several instruments at hand, and to vary the point of pressure. The weight in the groin may be suspended by means of a string or wire, so as just to produce the necessary pressure without fatiguing the patient by holding it in his hand. Mr. Hart has contrived a plan by which the exact amount of pressure exercised is registered upon the compressor. This may be useful in preventing an excess of force from being unadvisedly employed. Much valuable information on these and other points connected with instrumental compression will be found in Tufnell's work on the subject. See also the essay on Operative Surgery.

rate allowance of stimulants, if the patient has been accustomed to them, appears not to retard the cure, and certainly renders him more disposed to submit to it. Some surgeons, acting on the idea thrown out by Dr. Stokes (see p. 330), prefer to feed the patient on a diet almost exclusively of meat, believing that the blood is thus made richer in fibrin, and more prone to coagulation. Opium is sometimes necessary to procure sleep; but if the patient be not of an irritable disposition, and the pressure has been commenced mildly, he can generally sleep quite well when the instruments are withdrawn; and cases occur occasionally where the patient can sleep undisturbed even while the compressor is applied.

There are two main theories as to the best method of making compression in the cure of aneurism. The one adopted by the Dublin surgeons, as above referred to, is, that a slow current through the sac is, if not necessary, yet desirable, in order to the deposit of laminated fibrin; and that for this purpose the compression ought not to be applied to the artery tightly enough to stop the circulation. Consequently this plan involves a rather protracted treatment.[1]

The other theory is, that if the blood can be completely arrested in the sac by compression stopping the circulation absolutely for some hours, the soft coagulum which is at first formed will gradually go on to complete induration and lamination, and the cure will be thus effected much more speedily and much more surely. Experience is yet needed to show whether the slow or the rapid compression, *i. e.*, the partial arrest of the circulation for a considerable time, or its total suppression for a shorter period, is on the whole the best treatment, but plenty of facts exist to prove that aneurism may be cured in both ways.

[Mr. Holmes has since said (Lancet, May, 1875, p. 601), "There is now no doubt . . . that the filling of the sac with soft blood-clot, instead of being a dangerous or unfavorable proceeding, is usually the first step to a permanent cure. It is quite true that such soft clots sometimes melt away again, and that the aneurism, after apparent cure, resumes its pulsation, and may even begin to grow again; but this melting away of the clot is hardly ever accompanied by any other unfavorable symptom, and a resumption of the treatment is generally quite successful. This being the case, it is no longer considered either necessary or prudent to dally with the disease by merely reducing the force of the circulation through the tumor, instead of suppressing it altogether; and therefore the first object of the surgeon is to discover by what means the requisite amount of force can be most easily applied, so as to keep the aneurismal sac free from pulsation until it is filled with coagula, and its orifice so far obstructed as to resist further distension after the removal of the compression."]

The total suppression of the current in the aneurism is best accomplished by making pressure below as well as above the aneurism; and in ordinary cases the pressure can only be borne by keeping the patient more or less fully under the influence of chloroform [or ether]. Numerous cases are now on record in which the patient has been kept for many hours under chloroform and a cure has been effected.[1] In most cases it is true that digital compression, with intermissions, or partial instrumental compression, have been previously employed; but this has not been always the case.

[1] The time required for the success of the treatment by gradual compression varies remarkably. In 26 successful cases, reported in the Medical Times and Gazette, the time varied from 60 hours to 8 months, the average being 19 days. In some of the protracted cases, the cause of delay has been the inefficient way in which the treatment has been carried out. Thus in the case of a young woman who was under Mr. Prescott Hewett's care in St. George's Hospital, on account of popliteal aneurism, some years ago, the disease remained stationary, notwithstanding the constant application of pressure for months, but was cured in a few days after her transference to the care of a different nurse. It was discovered that the previous attendant had been in the habit of allowing her to remove the instrument and walk about the ward. In other cases, however, no such negligence can be detected, yet the cure makes no progress for a considerable time, when a favorable turn suddenly occurs, and the patient recovers rapidly. It seems impossible, with our present knowledge of the processes which go on in aneurismal sacs, to explain the reasons of these uncertainties; but the practical inference is, that as long as the tumor is not increasing, and the patient is not suffering from the treatment, it is reasonable and advisable to persevere.

[Mr. Holmes says (Lancet, Dec., 1874, p. 861), "The longest period during which compression has ever been applied to the same spot, as far as I know, was in Verdier's case, where the patient kept the apparatus applied to the external iliac artery for more than four years, sufficiently tight to command the circulation through the aneurism." According to Broca ("Des Anévrysmes," p. 749), the period was 5 years.]

[1] See the Biennial Retrospect of the New Syd. Soc. for 1865–6, and for 1867–8. The longest period of pressure under chloroform seems to have been 12 hours in a patient under Dr. Mapother's care. By a misprint in the second of the above cited Retrospects, it is said that a patient was kept under chloroform for 97 hours—9½ was the time.

The cases to which the method by total compression are most applicable are those of aneurism in the abdomen, where digital pressure is impracticable, and instrumental compression so painful that the patient must be narcotized in order to tolerate it. It might be employed, however, in any aneurism; and in popliteal aneurism might perhaps be tolerated without chloroform. Here, however, the milder methods have been so successful that I should not myself be disposed to recommend it under ordinary circumstances.

Auxiliaries to the treatment by compression may be sought in position of the limb and in direct pressure; but these methods must not be insisted on if they appear to cause distress, and thus endanger the success of the principal agent of treatment.

[It is also well to follow Dr. Carte's suggestion, and equalize the circulation by keeping the patient in bed for a few days on low diet, before beginning compression.]

Signor Ciniselli has written on the use of direct compression in the treatment of aneurism, in the Annali Universali di Medicina, 1867, vol. cxcix., p. 351.[1] Besides citing several cases in which direct pressure was used as an auxiliary to other means with apparent benefit, he refers to two in which it was the only agent used. One was a case of popliteal aneurism under the care of Brunker, related in the Brit. and For. Med.-Chir. Rev., Jan., 1840, in which pulsation ceased after five days; and the other a traumatic aneurism of the carotid under his own care, in which the pulsation disappeared after ninety-seven days. The agent of compression in both cases, was a large piece of soft sponge firmly bandaged on to the tumor, and wetted once a day to give it the required elasticity.

When compression succeeds, the case is precisely on the same footing anatomically as when the disease undergoes the process of spontaneous cure, so that the reader may be referred to what has been said upon that head in a previous paragraph. Sometimes the artery becomes thickened and contracted where the pressure was applied, and it is possible that it might become obliterated; but changes in the arterial walls are of rare occurrence, and take place probably only when compression has been exercised more vigorously and more continuously upon one spot than is either usual or desirable.[2] Usually when a limb is examined after successful use of compression, the artery above the tumor shows no tracé of its action (fig. 322). The tumor is generally quite firm, being filled with laminated coagulum; but sometimes a channel is seen, through which circulation has gone on in it. All this will be seen to be identical with the spontaneous cure. Enlarged anastomosing arteries are generally discovered, and this enlargement is usually and rightly regarded as one of the earliest and best symptoms of commencing cure.

The cure of aneurism by compression does not, however, always involve the obliteration of the sac, and does not, therefore, always involve the establishment of any new circulation. This point is illustrated by a preparation in St. George's Hospital Museum (fig. 323), in which a popliteal aneurism is preserved, which had been treated by compression of the femoral artery for more than two months. The sac lies between the artery and joint, and is entirely filled with laminated coagula, except a channel at the back, continuous with the artery and forming a part of its tube. This method of cure is, however, not to be desired, since the clot may yield again to the force of the circulation,[1] and thus the disease may recur.

The failure of this method is due sometimes to the anatomical distribution of the arteries, as, for instance, when a vas aberrans carries on the circulation through the aneurism from a point above that which is compressed, and probably with more energy the more the main trunk is obstructed;[2] or it is due to sloughing of the skin under the pressure, to the patient's indocility or constitutional restlessness (by far the most frequent cause of failure), or to some deficiency in the tendency towards coagulation, which renders the blood in the sac incapable of going through the processes necessary for a cure without a more complete interruption to the circulation than gradual compression furnishes, and which must therefore be sought by total compression or by ligature.

One great advantage, however, of the treatment by compression is, that when it fails it seldom fails totally; for if it does not succeed in curing the aneurism, yet in almost all cases it places the disease under more favorable conditions for cure. The obvious reason is, that it produces enlargement of the collateral vessels, and thus obviates the tendency to gangrene which is so decided in the lower extremity after the Hunterian operation upon the

[1] New Syd. Soc. Biennial Retrospect for 1867–8, p. 290.

[2] In Med.-Chir. Trans., vol. xliv., p. 189, will be found a case in which a varicose aneurism formed spontaneously at the part where pressure had been applied to the femoral artery many months before for the cure of aneurism.

[1] See Mr. Spence's case, quoted on p. 371.

[2] The case marked 24 in Dr. Bellingham's table (Med.-Chir. Trans., vol. xxxiv., p. 149) is an example of this peculiarity

Fig. 322.

Fig. 323.

Fig. 322.—Cure of popliteal aneurism by pressure. The artery remains pervious. The sac is seen to be filled with laminated coagulum. The asterisk points to the nerve spreading over the tumor. (From a preparation in the Museum of St. George's Hospital. Series vi., No. 121.)

Fig. 323.—The femoral and popliteal artery, from a patient who died about eighteen months after the apparent cure of an aneurism by pressure. The tumor had become stationary, and had given him no further trouble. The opening of an artery out of the aneurismal tumor is seen just below the letter *a*. The artery itself is perfectly pervious throughout; *b* shows the internal popliteal nerve. Almost the whole of the sac is seen to be occupied by laminated clot. (From a preparation in the Museum of St. George's Hospital. Series vi., No. 122.)

femoral artery. It seems highly probable, therefore, although at present the cases are too few to form any conclusion, that the mortality from gangrene will be found much smaller in cases treated first by compression, and afterwards by ligature, than in those where the artery has been tied at the outset.[1]

[Mr. Holmes's subsequent collection of a larger number of cases has led him to the opposite conclusion; the mortality proved to be greater instead of less. See note, p. 362.]

Compression, however, although it is usually harmless, if not beneficial, even in the cases where it is not entirely successful, is not always so. Cases do no doubt occur in which the aneurism increases with much greater rapidity after the application of the pressure, and goes on rapidly to bursting. In one such case the skin gave way, and the patient died of hemorrhage.[4]

[In another case (Agnew's "Surgery," p. 542) twenty-four hours after an apparent cure of a popliteal aneurism by pressure, pulsation returned in consequence of extreme emotion, the temperature began to fall, and mortification set in, the supposed result of detachment of a portion of the clot formed during compression and its lodgment lower down. In another case, reported by Mr.

[1] Med. Times and Gaz., Nov. 29, 1856. It might occur to the reader that this advantage will be in some respect balanced by the increased facility with which the blood would find its way into the artery above the sac, and thus carry on the circulation through it; but this does not seem to have been the case in any of the aneurisms so treated.

[4] Med. Times, 1860, vol. i., p. 118.

Pemberton in Med.-Chirurg. Trans., vol. xliv., p. 189, a communication formed several months afterwards between the femoral artery and vein at the point where the pressure had been made, resulting in an arterio-venous aneurism that caused the patient's death. In still another (Trans. Path. Soc. of Phila., 1871–2–3, vol. iv., p. 117), gangrene of the foot and leg appeared the day after a second attempt to cure a popliteal aneurism by compression maintained for thirteen hours, and caused the patient's death in a week. A bandage used in the previous attempt had caused an excoriation over the aneurism, which ulcerated into the sac; the reporter, Dr. Allis, attributed the gangrene to this accident. See also Gancel, "De la gangrène du pied et de la jambe, à la suite du traitement des anévrysmes du membre inférieur par la compression indirecte."]

As to pressure on the distal side of the sac, it appears in some cases to be very useful as an auxiliary to complete compression of the artery leading to the aneurism; but as the essential measure for the cure of the disease, it is not to be trusted. Still, trial may be made of this plan in aneurism at the root of the neck, where direct pressure might be dangerous, and where pressure between the heart and tumor would be impossible.

Digital Compression.

The treatment of aneurism by digital compression is of very recent origin. It has sprung directly from the successes, and it must be said, also from the failures, of the treatment by mechanical compression.

The first recorded case in which digital compression was successfully employed for aneurism appears to be that of a patient treated by M. Greatrex, in May, 1844, and whose case was recorded by that surgeon in the Medico-Chirurgical Transactions for 1845. In this case the thumb or fingers were applied over the femoral artery in the intervals of compression by a tourniquet. The aneurism, which filled the popliteal space, solidified in twenty-four hours under this joint treatment by digital and instrumental compression. Two years later, Professor Jolliffe Tufnell,[1] treating a popliteal aneurism by compression with a tourniquet at the groin, found his progress impeded by enlargement of the inguinal glands, and taught his patient to compress the femoral artery with his thumb until the swelling of the glands subsided. In both these cases the pressure by the finger was employed as a temporary aid to instrumental compression, rather than as a means capable of effecting the cure of an aneurism.

But in 1848 Dr. Knight[2], of New Haven, United States, for the first time employed compression of the femoral by the fingers as the sole means of cure. The case was one of popliteal aneurism in a mulatto forty-eight years of age, for whom every kind of tourniquet and apparatus had been vainly employed. Before having recourse to ligature, Dr. Knight made trial of manual compression of the femoral; he obtained the help of a number of assistants, who relieved each other, two and two every half hour, maintaining continued pressure to an extent which arrested pulsation in the tumor. At the end of forty hours the tumor was one-third smaller, hard, and pulseless. Compression was stopped, the cure was complete, and four months afterwards the tumor could hardly be felt. This success of Dr. Knight gave rise to other efforts in America. Dr. Fox,[1] in the Pennsylvania Hospital, applied digital compression to the treatment of an inguinal aneurism soon after the publication of Dr. Knight's case. He desisted from its employment, owing to the want of assistants, although much success had attended the trial. Mechanical compression was not well borne, and ultimately the external iliac was tied. His example was followed in the same year by Professor Willard Parker[2] and Dr. J. R. Wood,[3] of New York, who achieved successes in the treatment of femoral and popliteal aneurisms by the combination of digital and mechanical compression.

During this interval the Dublin surgeons had not published any case in which digital compression was employed. In 1852, Mr. Norgate[4] recorded a case of popliteal aneurism, in which pressure by the thumb was temporarily employed in succession to mechanical compression. The tumor ruptured, and amputation was resorted to with success. And in 1854 Jameson[5] obtained a cure by the mixed methods; he employed a Reid's compressor during six days ineffectually, introducing with successful effect six hours of digital compression. In another instance, Donohue, a patient of Mr. Colles in the Meath Hospital, Dublin, observing that by compressing the femoral artery in the groin he eased the pain of a diffused popliteal aneurism, quietly performed the compression during three days, so that when the surgeon came to fit on a tourniquet he found that his patient had cured himself.[6]

In Italy, Professor Vanzetti, of Padua, obtained, at this date (November, 1853) a striking success in the treatment of popliteal aneurism by manual compression; his patient was a healthy man, aged nineteen, the subject of a right popliteal aneurism of the size of an orange, and of five months' duration. Methodical compression was made, by the hands of assistants, at the apex of Scarpa's triangle,

[1] Dublin Medical Press, 1847, vol. i., p. 169.

[2] Transactions of the American Medical Association, 1848, p. 169.

[1] American Journal of Medical Sciences, 1849, vol. xxxvii., p. 377.

[2] Broca, p. 809.

[3] Dublin Medical Press, 1846, p. 150.

[4] Ibid., 1852, vol. xxvi., p. 247.

[5] Ibid., 1854.

[6] Ibid., May 1, 1854, p. 97.

and solidification of the tumor was effected in forty-eight hours, without pain and without diminution of the temperature of the limb. In 1855 Professor Vanzetti treated a second case of popliteal aneurism, in the person of a young officer, by similar means and with even more striking success. It was a spontaneous popliteal aneurism of two months' date; the knee was much bent. The patient himself was taught to compress the femoral artery, during three weeks, and many times daily, each time from six to eight minutes; partial solidification followed. Methodical compression of the femoral artery, at the same point as in the former case, was then applied during five hours, with the effect of solidifying the tumor, and affording a complete cure. Professor Vanzetti, in recording these cases, mentions also that he applied the same method to the treatment of popliteal aneurism at the hospital of Karkof in Russia, in 1846.[1] After two days, finding it unsuccessful, he passed at once to the ligature. It will be observed that, although unsuccessful and not published until 1858, this was the first attempt at curing an aneurism by manual compression solely; just as Dr. Knight's case, in 1848, previously mentioned, was the first instance of a cure actually effected by the sole use of pressure by the hand. Hence Professor Vanzetti claims a priority as inventor of digital compression, which has commonly been accorded to Dr. Knight.[2] The merit of strongly insisting upon the value of digital compression, and studying its applications to surgical treatment with a success which fixed the attention of European surgeons, is undoubtedly due to Vanzetti. These early successes were speedily followed by others equally remarkable. In July, 1856, a female patient came under the care of Professor Gioppi,[3] of Padua, the subject of aneurism of the ophthalmic artery; the case was one of great severity. The portrait of the patient fully confirms the written descriptions; the eye projected on to the cheek; it was motionless; the cornea was infiltrated and opaque; the sight was gone. The pulsating aneurismal tumor could be felt by introducing the finger between the globe of the eye and the roof of the orbit; the bruit could be heard loudly. The carotid was compressed for periods of a minute or two, and, with frequent intervals, by the convalescents of the ward and by the patient herself. Pressure continued for more than a minute produced fainting. Nevertheless, at the end of one day there was a visible improvement, and at the end of four days all pulsations had ceased. Four months afterwards the eye rested and moved naturally in the orbit; vision was restored, the patient remaining only somewhat short-sighted, and with the pupil slightly dilated. A second case, in which a formidable aneurism of the ophthalmic artery, in a patient the subject of aortic and cardiac disease, was cured by digital compression, was published, in 1858, by Drs. Vanzetti and Scaramuzza.[1] Intermittent compression of the carotid by the finger was here also employed for five minutes at a time, and a cure was effected by seven hours and twenty minutes of compression spread over eighteen days. These brilliant successes, real triumphs of conservative surgery, supported as they were by abundant and irrefragable testimony, sufficed to place digital compression amongst the most precious resources of surgery in the treatment of external aneurism.

The subsequent experience of surgeons who have employed this method since Vanzetti affords numerous instances of cure, unrivalled for simplicity, painlessness, ease, and rapidity, in the records of the treatment of aneurism by any other means. In nineteen cases successfully treated by digital pressure, the average number of hours of pressure was not more than forty-one and a half—spread, however, over a variable period of time, owing to intermissions of the pressure. In a case which came under my own notice in 1868, the patient, a policeman, had had a popliteal aneurism cured in Guy's Hospital, under Mr. Bryant's care[2] by digital compression in about twenty-four hours. He returned to his duty, and in about a year afterwards a second aneurism formed in the opposite ham. Of the nature of this tumor there could be no doubt, since it was verified by his usual medical attendant, who had previously placed him under Mr. Bryant's care. The man went to bed, and imitated so successfully with his own thumb and fingers the treatment he had seen pursued in the hospital, that he suppressed the pulsation in the sac completely and finally in four and a half hours. When I saw him there was no trace of the tumor beyond a little thickening in its old situation. Mr. Bryant informs me that he has since met with another case in which the patient had cured himself in the same manner.

Digital pressure ought to be effected, when possible, by the united efforts of a staff of trained assistants (in hospital practice, usually medical students), who should make pressure in pairs each for

[1] Annali Universali di Medicina, Jan., 1858.

[2] Priorità del Metodo di curare gli Aneurismi colla sola mano, dovuta alla Scuola di Chirurgia dell' Università di Padova, del Prof. Tito Vanzetti. Annali Universali, vol. clxiii.

[3] Annales d'Oculistique, 1857.

[1] Secondo caso di Aneurisma dell' Arteria ottalmica guarito colla compressione digitale della carotide, etc., dell Dott. T. Vanzetti, etc., etc. Padova, 1858.

[2] Guy's Hosp. Reports, series iii., vol. xiv., p. 241. A case of traumatic aneurism of the femoral artery, under M. Chassaignac's care, cured in seven hours by digital compression, is related in L'Union méd., Dec. 2, 1862. Here, however, the compression was continued as a precaution more or less during the next twenty-four hours.

about ten minutes, relieving each other alternately. The one who is not compressing should see that the other holds the artery firmly, and commands the circulation through the tumor completely during the whole period. The point of pressure should be varied whenever that is possible, and great care should be taken to impress upon the assistants, especially if they are entirely ignorant of medicine, the proper direction of the pressure by which the artery can be held with the least force, and the great importance of not using more pressure than is absolutely necessary. A reasonable time must be allowed for sleep, at least in most cases, undisturbed by pressure. Some patients can tolerate the constant application of the compression for a day or two. It should not be forgotten that digital pressure is by no means always painless, but on the contrary sometimes more painful than instrumental compression. In such cases it should be given up, and the latter method substituted.

[Fischer's statistics, quoted by Holmes, contain 90 cases of aneurisms treated mainly or wholly by digital pressure, giving 76 complete cures and 8 deaths (6 after ligature and 2 after amputation). In about one-third of the successful cases the cure was effected within the first twenty-four hours, and Mr. Holmes therefore recommends that pressure should be kept up for this length of time, and then followed, if necessary, by instrumental pressure or by intermitting digital pressure, two hours at a time twice a day.

Maunder recommends (Surg. of the Arteries, 1875, p. 15, and Brit. Med. Journ., 1878, vol. i., p. 750) the use of morphia instead of an anæsthetic, as an aid to compression. He also used as an indicator of the accuracy of the compression in a case of popliteal aneurism, a pen-holder carrying a piece of paper between its nibs, which was placed upright in the bend of the knee, the thigh resting upon its outer side.]

The cures, however, which are effected by digital pressure are often very rapid, and attended with less pain than any of the other methods; and this kind of compression can occasionally be applied to arteries, such as the carotid, where mechanical pressure is hardly practicable.

[Treatment by Esmarch's Bandage.

A recent addition to the methods of applying the compression treatment is found in the use of the elastic bandage and tubing introduced by Esmarch for the purpose of rendering limbs bloodless during operation. It was first employed by Dr. Walter Reid, of the British navy, in 1875, in a case of popliteal aneurism.[1] He carried the bandage tightly up the leg, loosely over the tumor, so as not to compress it, and then tightly again over the lower third of the thigh. The rubber tubing was then applied, and the bandage removed. At the expiration of fifty minutes, the pain had become so severe that the tube was removed, two Carte's compressors having first been adjusted over the upper portion of the femoral artery. By their aid the circulation was controlled for two hours longer, when the aneurism was found to be pulseless. As a precaution, intermittent pressure with the tourniquet was maintained for a day or two, and then the patient was pronounced cured.

The case attracted so much attention in England that, within two years, Waquet[1] was able to give the details of seven published cases, all by English surgeons, and all but one successful. A year later, Petit[2] collected twelve additional cases; and in January, 1879, Dr. R. F. Weir[3] added five more to the list, one being his own. In January, 1881, I collected[4] sixty-two cases in which the bandage, or the rubber tubing, or both together, had been used for the cure of aneurism. With three exceptions (axillary, internal circumflex, and anterior tibial) the aneurisms thus treated were all of the popliteal or femoral artery, and the great majority were popliteal.

At the death of Dr. Reid's patient, a few months after the operation, the aneurism was found[5] reduced from its original size of a hen's egg to that of a small walnut; it was filled by a dark mass of cheesy consistency, evidently the remains of a blood-clot, and on some portions of its wall were strata of laminated fibrin, some of which were partly split off and turned inwards. The wall of the sac was well defined and not thick. The artery was obliterated by fibrous tissue for two and a half inches above the sac. The laminated fibrin was thought by Dr. Reid to have formed during the earlier attempts to cure by compression, and the displacement of portions of it to have been the result of the shrinking of the sac.

A similar condition was found at the second and only other recorded autopsy after a cure by this method;[6] there was a central blood-clot, and the artery was occluded, but there was no laminated fibrin, and the wall of the sac was very much thickened.

In the two fatal cases, in which death followed as a consequence of the operation, the sac was found filled with soft, recent clot,

[1 Lancet, Sept. 25, 1875.]

[1 Sur le traitement des Anévrysmes des membres au moyen de l'appareil élastique d'Esmarch, Paris, 1877.]

[2 Bulletin générale de Thérapeutique, 1878, vol. xciv., pp. 458, 504, 543.]

[3 American Journal of Medical Sciences, Jan., 1879.]

[4 American Journal of Medical Sciences, April, 1881.]

[5 Lancet, Aug. 5, 1876.]

[6 Wagstaffe, Lancet, 1876, ii., p. 461, for case, and Trans. Path. Soc., vol. xxix., p. 72, for autopsy.]

which in one of them extended up the artery (the anterior tibial) to and into the popliteal.

These autopsies indicate the process by which a cure is obtained in the successful cases: the blood retained within the sac coagulates during the application of the bandage; the clot increases during the subsequent compression of the artery, and occludes it at its point of junction with the sac so effectually that no blood passes through. As the serum is absorbed and the clot shrinks, the wall of the sac follows it, and may also increase in thickness, probably as the result of the irritation of the clot. The same irritation of the wall of the artery near the orifice of the sac leads to the formation of granulations which permanently close the vessel. The incompleteness of the clot, and the subsequent occlusion of the artery by it, are shown by the fact that in the majority of the recorded cases of cure pulsation was noticed in the sac on the removal of the bandage, if the artery was not compressed, but remained permanently absent after compression, digital or instrumental, had been maintained for a few hours.

The same facts explain the frequent failures, which present two clinical forms. In one the tumor shows no change on the removal of the bandage: coagulation has not taken place. In the other, after a period of variable length, during which pulsation has been slight or even entirely absent, it reappears with its original force, and the aneurism continues to increase. The blood has found its way past the clot, the more freely as the latter contracts, and has redistended the sac.

The sixty-two cases I collected were grouped in three classes, according to the method of treatment. In the 1st, which embraces fifty-two cases, Dr. Reid's method was used with or without certain slight and apparently unimportant variations; in the 2d, five cases, the elastic bandage or the rubber tubing alone was repeatedly used alternately with a tourniquet or digital pressure, to arrest the circulation completely for several hours; in the 3d, five cases, the bandage was used for a short time each day for many days, without any compression of the artery in the intervals, or with a tourniquet loosely applied.

The fifty-two cases of the 1st group furnish twenty-eight cures, twenty-two failures, and two deaths. Of the cures, twenty-four were obtained by a single attempt, and four by two attempts separated by an interval of from one to four days. The bandage was applied in a majority of the successful cases for about an hour, the extremes being fifty minutes and three and a half hours; in some, it was carried loosely over the tumor, so as not to compress it; in others, the tumor was left entirely uncovered, and in some the patient was made to stand up after the bandage had been placed upon the leg, and before it had been placed upon the thigh, in order that the sac might be fully distended. In two cases Mr. Heath bandaged the thigh from above downwards, so as to over-distend the sac, thinking that by this means the tendency to coagulation would be increased, but he adds that experiments subsequently made to verify the theory gave a negative result. After the removal of the bandage the artery above the tumor was compressed with the tourniquet or the fingers, usually for from two to nine hours, but in one case for only one hour, and in another for five days; in one case genuflexion was substituted for pressure above. In two or three cases pulsation returned the next day, and was then definitely arrested by compression for a few hours.

In twelve of the twenty-two failures, the same method was pursued in nineteen different attempts; in the remaining ten, with eighteen attempts, no pressure seems to have been used after the removal of the bandage, but in one of these the bandage was kept on for six hours, and in another for three hours, periods longer even than some of those during which the combined use of the bandage and tourniquet had effected a cure. In at least five of the first twelve the method was thoroughly and skilfully employed, with every detail used in most of the successful cases; the sac was kept full, and the pressure was maintained for a sufficient length of time. They show therefore, when added to the twenty-eight successful cases, that the method even when rigorously employed may be expected to fail in at least fifteen per cent. of the cases. With reference to the remaining seven of these twelve failures, it may be objected with some reason that the method was used improperly or for an insufficient length of time; as the details are not fully given, this question cannot be settled.

The relative percentage of success, however, is not sufficient to determine whether the method should or should not be used. If an attempt involves no risk, if its failure leaves the patient as fit to undergo other treatment as he was before, it would be not only proper but perhaps even obligatory to make it, even if the percentage of success was much less.

The alleged dangers are of three kinds: 1st, gangrene, as the result of the size or extension of the clot; 2d, the greater probability of the occurrence of gangrene if recourse must be had to the ligature after failure; 3d, such as may arise in consequence of the increased arterial tension in the other parts of the body during the attempt.

1. Death has followed the employment of the method in two cases; in the one with apparently impending, in the other with fully developed, gangrene. The cases are those of Dr. Weir and Mr. Rivington.

In Dr. Weir's case[1] the bandage was applied twice with an interval of three days, and retained on the last trial for nearly eight hours. The patient died twenty-seven hours afterwards with symptoms of heart failure or shock, the dorsum of the foot remaining cold. In Mr. Rivington's case[2] the aneurism (of the anterior tibial) had ruptured externally before the patient came under observation, and amputation was refused, although strenu-

[1 Archives of Medicine, vol. iii., 1880, p. 207.]

[2 Lancet, Oct. 16, 1880, p. 608.]

ously urged by the surgeons. On the eighth day a line of demarcation had formed in the lower third of the leg, and a few days afterwards the patient died.

2. The second question, that of the greater probability of the occurrence of gangrene, if recourse must be had to the ligature after failure of elastic compression, is raised by Mr. Bryant's experience in one case, and by the fact that this probability has been shown to be increased after ligature by previous compression of the artery by the tourniquet or finger.

Mr. Bryant[1] applied the bandage twice, for three hours each time, with an interval of four days, for a popliteal aneurism in a man of forty-five. A fortnight after the second attempt he tied the femoral artery with catgut; the wound healed by immediate union, but the foot "soon became the seat of anæmic gangrene, and a fortnight after the application of the ligature was amputated in the middle of the leg, and a good recovery followed."

This is the only instance of gangrene in the sixteen cases of the list in which it is recorded that the ligature was used after failure of the bandage, and the number is too small to determine whether or not the proportion is greater than that following simple ligature, two or perhaps three, in eighty-seven according to Mr. Holmes.[2]

But even if gangrene should be twice as frequent after secondary ligation, its relative frequency in the total number of cases treated by the bandage would probably not be greater than after primary ligation. The explanation suggested by Mr. Bryant, and probably the correct one if a causal relation exists, is the plugging of the small arteries by fragments of the clot.

3. It has been shown by observations made with the sphygmograph that while the elastic bandage is upon a limb the intra-arterial pressure is increased throughout the other portions of the body, and it has been suggested that this increase might be dangerous if certain conditions of the heart or arteries should coexist. No accidents from this cause have yet been recognized, and if such a contra-indication should exist in any given case, the danger can be avoided by using the tubing alone, as has been done in two cases. By this means the amount of blood normally contained within the limb would be retained there during the operation, and would not be forced out to augment that contained within the other portions of the circulatory system.

The second of the three groups into which the list is divided contains five cases, those in which the bandage or the tubing alone was used two or more times, alternately with instrumental or digital pressure, to arrest the circulation for several hours.

In the third group, five cases with three successes and two failures, the method employed was radically different. Three of the cases were treated by Gersuny,[1] one by Raab,[2] and one by Esmarch.[3] The general plan was to apply the bandage and the tubing with just sufficient force to arrest the pulsation, and to leave it in place for about half an hour; to repeat this daily or twice a day for several weeks, and to compress the artery with a tourniquet or shot-bag for two or three hours after each application of the bandage. For the particulars of the cases in these two groups the reader is referred to the original sources given above, or to my paper on this subject in the Am. Journal of the Medical Sciences, April, 1881.

The conclusion to be drawn from all these cases seems to be that we have in the elastic bandage an efficient means for safely shortening the duration of the treatment by compression of popliteal and some femoral aneurisms. The greater efficiency, the more speedy action, of the method is apparently due mainly if not entirely to the arrest of the circulation through the collateral channels as well as through the main artery, thus securing the absolute stagnation of the contents of the sac. Consequently, the rubber tubing which is drawn tightly twice or three times about the limb above the aneurism is to be considered the efficient part; and the principal, perhaps the sole, benefit from the bandage is that of making a less severe constriction by the tubing sufficient.

The details of the method involve the retention of the bandage or tubing for one or two hours, and the compression of the artery by a tourniquet or the fingers for several hours afterwards. This compression should be firm enough to prevent the flow of blood through the artery, but after it has been kept up for an hour or two it should be temporarily intermitted, as Dr. Weir suggests, in order to ascertain if pulsation returns in the sac. If pulsation returns within a few hours after an apparent cure has been obtained, the artery must be again compressed for some time. The elastic bandage should not compress the aneurism, for the cure is to be effected by filling the sac with a clot, and if this clot is smaller than the natural capacity of the sac it will be easier for the blood to make its way into the latter after the removal of the compression, and thus perhaps prevent a cure. If the primary clot has extended upwards into the artery, this of course is less likely to happen, but as the surgeon cannot be sure that such extension will take place, it is prudent to act as if it would not. On the other hand, hyper-distension of the sac, as practised by Mr. Heath, seems unnecessary and perhaps even dangerous. The clot is in itself a source of irritation to the wall of the sac, and if this slight irritation is increased by extreme tension, it may pass beyond the degree which leads to tissue-production, and cause suppuration.

The introduction of needles or of a coagu-

[1 The Practice of Surgery, 3d Amer. edit., p. 345.]

[2 See note, p. 353.]

[1 Gersuny, Archiv für Klinische Chirurgie, 1879, vol. xxiv., p. 798.]

[2 Ibid.]

[3 Centralblatt für Chir., 1879, vi., p. 65.]

lating injection has been suggested but never yet practised. It might be proper in a second application in those exceptional cases in which the first trial has not caused coagulation, but as it involves a slight risk of suppuration, it will probably be thought advisable not to employ it in the first attempt.]

Treatment by Flexion.

The simple bandaging of the limb in acute flexion, the patient being kept at rest, may occasionally succeed in curing aneurisms situated at the bend of the limb, as in the popliteal space or the elbow, and possibly in the groin. This plan of cure had been previously tried; but the merit of first demonstrating its success is fairly due to Mr. Ernest Hart.[1] All that is requisite in this treatment is to bandage the limb from the toes nearly to the knee with a roller, and then to turn the roller round the thigh flexed at an acute angle; the limb should then be bent upon the pelvis, and the knee rested against a pillow.

In Mr. Hart's case, the cure had made considerable advance after the first day of the treatment, and was complete on the fourth day; on the seventh the patient was moving about. In Mr. Shaw's case, the cure was much more protracted, and the cessation of pulsation was not reported till the thirty-eighth day, but then the tumor was larger. In neither of these cases was any rigorous system of diet enforced, nor did the patient complain of the least inconvenience in either. In a patient under my own care,[2] the aneurism, which was small and recent, was cured, without any inconvenience or distress to the patient, in two days. Numerous other successful cases have been put on record. The most interesting and important of these, in which genuflexion succeeded after the failure of the Hunterian operation, and of instrumental compression on the femoral artery, is reported by Mr. Spence in the Edinburgh Medical Journal for November, 1859, p. 434. The patient applied for advice originally in May, 1857, on account of an aneurism, which had only been noticed a month, and which increased so rapidly while he was under observation, that the femoral was tied below the origin of the profunda without further delay. There was some apprehension of gangrene after the operation, showing apparently that the circulation was re-established only slowly. The ligature separated on the twenty-ninth day, and then some undulatory pulsation was noticed in the tumor, which, however, was much diminished in size. By bandaging the limb, cautious compression of the femoral artery, and direct pressure by a compress of lint over the tumor, this pulsation was reduced to a line corresponding to the course of the artery, and not larger than the popliteal on the other side. The patient was then discharged, and returned to his avocation, that of a coal-carter. In August, 1858, he came to the hospital again, as the tumor had suddenly increased within two or three days. It was then found to be as large, and pulsating as violently, as before the artery was tied. Compression was tried, and persisted in for five months, but the tumor increased instead of diminishing. It was then proposed to tie the femoral artery low down, *i. e.*, in Hunter's canal, since the upper part of the superficial femoral appeared obliterated. Previous to this, however, it was thought right to give a trial to the flexion treatment; and this succeeded so well, that in a week the pulsation had very much diminished, and in a month the aneurism was quite cured, its contents being perfectly solid, and the anastomosing vessels enlarged. The man again returned to his laborious avocation, and was presented to the Medico-Chirurgical Society of Edinburgh four months afterwards; the cure being quite complete.[1]

It ought to be noticed here that this man could not at first bear the complete flexion of the limb; accordingly a slipper, with a piece of bandage sewn to the heel, was fastened on the foot, and the bandage was then attached to a loop connected with a broad band round his pelvis, and this loop was gradually tightened, so as to increase daily the flexion of the leg on the thigh. The confinement to bed appears to have lasted little more than a fortnight. This milder plan of employing flexion may be often found successful when the patient cannot tolerate more rigid confinement.

Many cases are also reported in which flexion has been successfully used in combination with pressure. In one under the care of Mr. Pemberton,[2] the amount of pressure used was so slight that no great importance is attached by him to its action. Yet the aneurism, a large one, and pulsating strongly,

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[1] For the details of this case, which I had the opportunity of seeing, in consultation with Mr. Hart, before the commencement of the treatment, see Med.-Chir. Trans., vol. xlii., p. 205. In the same volume is the report of a similar successful case under the care of Mr. Shaw. The plan is understood to have been tried some time ago on a patient of Sir W. Fergusson at King's College Hospital; but it seems likely that the trial was not very persistent. The details have been lost; and the fact was first mentioned after the publication of Mr. Hart's case. Mr. Hart's case occurred in 1858. It seems, however, that the method was successfully used by Dr. Th. Maunoir. of Geneva, in 1857. See Richet, in Dict. de Med. et de Chir. Pratiques, vol. ii., p. 339.

[2] Brit. Med. Journ., 1868, vol. i., p. 585.

[1] A second case, under Mr. Hart's care, was communicated to the Royal Medical and Chirurgical Society, in which the cure was effected in a few days without even confinement to the recumbent position. (Proceedings of the Royal Med. and Chir. Soc., vol. iv., p. 37.)

[2] Lancet, Sept. 3, 1859, p. 232.

was cured in less than twelve hours. A somewhat similar case is reported by Mr. A. Pritchard, of Bristol, in the British Medical Journal, March 30, 1861.[1]

[Prof. Van Buren (Trans. International Med. Congress, Phila., 1876, p. 559) mentions two cases of inguinal aneurism cured by flexion of the thigh; one, treated by Buck, was a recurrent aneurism after ligature of the external iliac; the other, by Dr. Eldridge, of Yokohama, was cured in twenty days. He refers also to a case in which Dr Edward T. Caswell, of Providence, R. I., cured a double popliteal aneurism by genuflexion short of completely arresting the pulsation; and to one in which Dr. Montgomery cured a traumatic aneurism at the bend of the elbow by flexion for twenty-four hours.]

The failures which have hitherto been recorded appear not beyond what any other method of treatment is exposed to.

Thus in Mr. Moore's case, above referred to (p. 357), flexion was tried unsuccessfully; but then the tumor was large, and was growing rapidly towards the joint; and such cases are peculiarly intractable. In a case under Mr. Paget's care,[2] this method was tried, and failed; but in that case other methods of treatment also failed, the case not being one of aneurism in the proper sense of the term, but of ulcerated artery without a sac.

A case was in St. George's Hospital in 1867 of popliteal aneurism of two months' duration, in a man aged twenty-six, of dissipated habits. Flexion to about a right angle nearly but not quite stopped the pulsation. After eleven days of flexion the pulsation had ceased entirely. It recurred, however, though to a very slight extent, from time to time, and the limb continued to increase in size, until a portion of the swelling suppurated; and then bleeding occurred from the tumor, necessitating amputation. On examining the limb the artery was found completely divided into two parts. No mention is made of any obvious disease in the coats of the artery.

M. Liégois[3] gives an analysis of forty-nine cases of popliteal aneurism treated by flexion, founded on a thesis by M. Stopin. Twenty-six were cured, flexion being used alone in eleven cases, and in four after other methods had failed. In the remaining eleven flexion was used in combination with other measures. Out of the twenty-three cases which failed, seven are stated to have suffered rupture, and one inflammation of the sac.

The cases best adapted for the trial of flexion are the simplest. In those cases where the tumor is not of very large size, where the parts covering it are not much inflamed, nor the joint involved, and where, as far as can be ascertained, the tumor is seated on the superficial face of the artery, we may anticipate benefit from flexion. If the flexion of the limb entirely, or almost entirely, suspends the pulsation and the bruit, this treatment may be trusted by itself; otherwise a compressor must be applied to the artery above, in aid of the flexion. But the compression need not, in such a case, be applied with nearly the same severity which would be demanded in an ordinary case.[1] A very slight amount of pressure will often serve; and if the only advantage of this simple and nearly painless proceeding were to spare the patient the annoyance of severe pressure, it would be no slight one. There are, however, many cases in which the aneurism will be entirely cured by it, without the smallest risk either to life or limb.

Treatment by Manipulation.

A method of treatment has been founded on the consideration of the pathological changes which by the deposition of fibrin and occlusion of the cavity of an aneurismal sac lead to its cure, and the analysis of certain cases in which the accidental displacement of clot from within the sac, and its impaction in the artery on the distal side of the aneurism, has seemed to give rise to exceptional cures. Sir W. Fergusson has endeavored artificially to imitate this process by means of a particular manipulation of an aneurism, whereby the fibrin within may be so displaced as, either in part or in whole, to block up the main artery on the distal side of the disease.

In a paper which will be found in the Medico-Chirurgical Transactions, vol. xl., p. 1, that surgeon describes two cases which he submitted to this treatment. Both were cases of subclavian aneurism. The first patient was a healthy-looking man of middle age, having a large aneurism of two years' standing, involving chiefly the middle part of the artery. In the event of any operation by ligature having been determined on, the vessel must have been tied either on the tracheal side of the scaleni, according to the Hunterian method, or on the distal side, according to the method of Wardrop or Brasdor. Sir W. Fergusson thus describes his proceeding: "The patient was seated in a chair; and I placed the flat end of the thumb on the aneurismal tumor so as to cover the prominence. I then pressed, until all the fluid blood had passed from the sac, and I could feel that the upper side of the aneurism was

[1] See also a case by Mr. Colles, in the Dublin Hospital Gazette, June 15, 1860; and one by Dr. Leith Adams, Med. Times and Gazette, Jan. 26, 1861.

[2] Medical Times and Gazette, 1859, vol. ii., p. 505.

[3] L'Union méd., August 14, 1869, p. 236.

[1] See Mr. Pemberton's case, above referred to.

pressed against the lower. I now gave a rubbing motion to the thumb, and felt a friction of surfaces within the flattened mass. The movements were little more than momentary, but they were such as I had preconceived." The immediate effect was to produce giddiness and mental confusion, so that the patient was for a time unable to stand. Pulsation ceased in the arteries below the tumor, and pain was experienced in the hand and forearm. In the evening, however, pulsation had returned in these vessels. Next day the manipulation in the way described was repeated, with much the same immediate effects. Pulsation returned slowly, after some days, in the arm and hand. The tumor was thought to have become manifestly less in size, and to pulsate less strongly. It never ceased, however, to pulsate, and eight months after the patient died, owing to rupture of the sac at the lower and back part. It was found to contain solid fibrin of old date, and recently coagulated blood. The axillary artery was filled with a firm plug of fibrin. In the second case so treated by Sir W. Fergusson, paralysis of the left side of the face, and of the left forearm and leg followed the first manipulation, the pulse ceasing at the wrist. With this exception, there was little material change. At the end of two months the patient resumed his occupation as a seaman, having regained the use of his left side, but the tumor being apparently unaltered. A year after, he was again seen, and an attempt made to keep up continued pressure on the tumor; but it proved so unsatisfactory that it was given up. Again, at the end of the year, that is, two years after the first employment of manipulation, he returned; and now the tumor had completely disappeared, there was not a trace of it to be perceived; a slight pulse could be felt at the wrist. The arm seemed much the same as its fellow, and the paralysis of the left side had gone off.

Neither of these cases afforded satisfactory evidence of the efficacy or safety of this mode of treatment. In the first case, although the tumor was considered to be somewhat solidified, it never ceased to pulsate; and after a few months caused the death of the patient by bursting. In the second case no perceptible effect was produced on the tumor at the time, nor did it seem to be much changed at the end of a year; but after two years of laborious occupation, the tumor was found to have disappeared. It must be considered doubtful how far this result was due to spontaneous changes, or to accidental displacement of the contents of the tumor in the course of the patient's frequent exertions.

The sudden faintness of both these patients immediately after the manipulation of the tumors, and the paralysis which followed in the second case, indicated sources of danger connected with this treatment, which Sir. W. Fergusson did not omit to point out. It seemed possible that in the manipulation some of the broken-down fibrin was squeezed towards the mouth of the vertebral or carotid arteries, and by obstructing the flow of blood to the brain produced hemiplegia in the manner suggested by Dr. Kirkes, who, in a paper read before the Medical and Chirurgical Society in May, 1852, pointed out the probability of this condition being produced by fibrin from the valves of the aorta being carried along mechanically in the blood. A case highly illustrative of this danger has since been described by Prof. Esmarch.[1]

Captain C. H. consulted a friend of Prof. Esmarch's for tonsillitis, and at the same time drew his attention to a tumor on the left side of his neck, which had formed suddenly three years previously, without appreciable cause, and had now attained the size of a hen's egg. It was easily diagnosed as an aneurism of the common carotid. On repeating the examination a few days later, and exerting pressure upon the tumor for the purpose of reducing it, the patient fell suddenly back with symptoms of apoplexy; he was at once bled, and conveyed to the hospital, where he was placed under the care of Dr. Esmarch. There was right-sided cerebral paralysis; the pupils were dilated, but reacted to the light; the tumor pulsated simultaneously with the carotids, but presented no murmurs. Prof. Esmarch diagnosed the detachment of fibrin from the aneurismal sac, and consequent obliteration of the left carotid. Death ensued three days afterwards. At the autopsy, performed by Prof. Weber, of which the most careful details are given, the sac of the large aneurism was found to be partly lined with more or less firmly attached, ragged, fibrinous coagula; much loose fibrin irregularly interwoven was also in the sac; a firm coagulum was drawn out of the internal carotid, and this coagulum was found to extend up to the carotid foramen. There was no coagulum in the external carotid. The cerebral carotid, the middle cerebral, and the ophthalmic artery were completely blocked up with coagula of a dark-brown color, inclosing numerous red and grayish-white plugs, which evidently were derived from the aneurism. Their identity was proved by the microscope. There was considerable softening of the middle of the left hemisphere, including the corpus callosum.

A somewhat similar accident was described by Mr. Teale, of Leeds, in some clinical remarks delivered in 1859.[2] He mentions that in the year 1847 he was one of a numerous consultation in a doubtful case of carotid aneurism. The subject of it was a middle-aged female, in good health in other respects. She was seated in a chair while the tumor was examined by several persons in succes-

[1] Virchow, Archiv für Path., Anat. und Physiologie, vol. xi., p. 410, 1857.

[2] Med. Times and Gaz., March, 1859, p. 265.

sion, and subjected by them to repeated handling and compression. While this was going on, she suddenly became pale and slipped off the chair. On being raised, she was found to be hemiplegic; after lingering in this state a few weeks she died. The tumor was found after death to be aneurismal.

These two cases serve to show very strongly the dangers which, as Sir W. Fergusson himself pointed out, are likely to follow the manipulation of aneurismal tumors of the neck. On the other hand, subclavian aneurisms are almost always ultimately fatal, and have never yet been successfully treated by the Hunterian ligature.

Soon after the publication of Sir W. Fergusson's paper, Mr. Robert Little[1] admitted into the Donegal Infirmary an albino, aged fifty-three, having an aneurism of the right subclavian artery of nine months' duration, of considerable size, pulsating strongly, having a loud bruit, soft and compressible, somewhat red and inflamed on the cutaneous surface. Anodynes, sedatives, local refrigerants, and venesection were employed without effect. On January 1, 1856, by making gentle but steady pressure with the thumbs alternately over the aneurismal sac, Mr. Little succeeded in displacing some of the coagula, and directing them towards the distal opening of the artery. No other local treatment was adopted; but the patient was ordered a preparation of iron internally. For the first two days no change was perceptible either in the tumor or the arm; but on the third day the pulse at the wrist was manifestly weaker, and the arm somewhat colder than the opposite one. The symptoms gradually increased up to the tenth day after the manipulation of the sac, when no pulsation could be felt in either the radial, brachial, or axillary arteries. From this time the tumor itself gradually became more solid, and finally all pulsation ceased. The tumor wasted to the size of a small walnut, and two superficial arterial branches could be traced running transversely across it; one immediately above the clavicle, the other somewhat higher up. For a time the arm was partially paralyzed and very cold, but it subsequently recovered sensation and motion, and when the patient was seen a year afterwards his cure was in all respects complete.

In addition to this highly satisfactory and interesting cure, Mr. Teale, of Leeds, and Dr. G. C. Blackman, of Cincinnati, have each successfully treated an aneurism of the lower extremity by manipulation. Dr. Blackman[2] received under his care, in April, 1857, a man, the subject of a large femoral aneurism, measuring five inches at the base. After forcibly manipulating the tumor with the view of dislodging the fibrinous contents, a Skey's tourniquet was applied to the femoral artery immediately below Poupart's ligament. Much pain was complained of in the tumor, and the pulse rose to 110, being full and strong. The patient was bled to nine ounces, with the effect of diminishing the pain, and bringing the pulse to 50, soft and regular. After four days the tourniquet was taken off, the leg was bandaged, and as the pulse was still high, venesection was again employed, and opium and tartarized antimony administered internally. On the tenth day pulsation had altogether ceased. The cure remained good. The femoral artery is described as being plugged as far as the origin of the profunda, while in the popliteal space the pulsation of the artery was hardly perceptible.

It is not, however, very easy in this instance precisely to define the respective effects of the treatment by compression and that by manipulation, although the latter may be considered to have played an important part in producing the cure.

[Mr. Holmes refers in his Lectures (Lancet, 1873, i., p. 159) to five cases of subclavian and two of femoral aneurism treated by this method, and says, "Yet, out of seven cases in which it has been tried, there is no clear proof of rupture of the sac in any one, and only a suspicion in a single case; while there is clear evidence of cure in two, and a good advance towards cure in another." . . . "Such being the present experience of manipulation, I think it justifies the repetition of the proceedings in a suitable case of subclavian aneurism. . . . The cases which would be looked upon as favorable for manipulation are those in which there is some evidence of deposit of fibrin in the sac from the thickening of its walls, where the aneurism is not of large size, and where its distal extremity is easily accessible to touch; so that the surgeon has a rational prospect of forcing some of the clot into it."]

In the case treated by Mr. Teale, compression of the femoral at the groin had been employed for some days, in the treatment of a popliteal aneurism, with the effect of producing some deposition of fibrin in the sac and enlargement of collateral vessels; but no material improvement having been effected, Mr. Teale attempted to produce displacement of the fibrin in the sac by moderate manipulation. The first attempt excited little change; he then repeated the manipulation with greater freedom, "kneading the tumor in various directions." An hour and a half after the last manipulation, the tumor had entirely ceased to pulsate, and had become a solid mass. Eleven days subsequently the patient left the hospital cured, the tumor having decreased rapidly in size, and he having been able to walk about the ward a few days.[1]

From the data furnished by these cases, which are the only ones bearing on this mode of treatment which I have as yet met

[1] Med. Times and Gaz., May 23, 1857.

[2] Western Lancet, June, 1857; New York Journal of Medical Science, 1857, p. 291.

[1] Med. Times and Gaz, p. 265, March, 1859.

with, a judgment may be formed of the uses and dangers of the ingenious but somewhat hazardous practice of manipulation in the treatment of aneurisms.

Treatment by Coagulating Injections.

The treatment of aneurism by the injection of a coagulating fluid into the centre of the tumor is so uncertain and so little used that a short account of it must suffice. The first proposal was put forward by Monteggia,[1] who suggested alcohol, acetate of lead, and tannin as coagulating agents. Wardrop[2] suggested acetic acid, advising also compression so as to stop the circulation above and below the tumour. But since the experiments of Pravaz on the effects of perchloride of iron, that substance has been chiefly if not solely used. Upwards of thirty cases so treated have been collected; and there can be no doubt of the possibility of thus coagulating a large portion at any rate of the blood in an aneurism. But this cannot be done without great danger. The dangers proceed either from inflammation and abscess, set up in the neighborhood of the sac, from inflammation of the sac itself, producing gangrene, or rupture of the aneurism, or from the consequences of embolism. In eighteen collected cases, the injection proved fatal four times; twice from gangrene of the limb, once from hemorrhage following gangrene of the sac, and once from phlebitis. This is a formidable roll of accidents and a large proportion of deaths. It will seem yet larger, when we remember that it is a condition of primary necessity now recognized by all surgeons, that before the method of injection can be applied, it must be possible to arrest the current of the blood by pressure on the artery above and below the tumor. Thus it would be possible in nearly all these cases to apply either instrumental or digital compression or flexion; proceedings which can count a larger proportion of successes, and which are not open to the same objections.

The treatment by injection has been applied to nearly every form of external aneurism: to popliteal aneurism, by Niepce, Lenoire, Minor, and Isaacs; to carotid aneurism, by M. Dufour; to aneurisms of the elbow, by M. Jobert, Serres d'Alais, Valette, and Dieulafoy; and even to aneurisms of the innominate, by M. Barrier; of the subclavian by Pétrequin; and of the aorta by Syme. The last three varieties are totally out of the domain of this method of treatment, because they are inaccessible to the compression of the artery on their cardiac and distal side; and without this precaution, the small clots formed by each drop of the perchloride on its entering the sac, are likely, as has been proved by experience, to be carried by the blood into the ramifications of the artery and produce gangrene. To repeat those experiments would therefore now be unjustifiable. Aneurisms of the popliteal artery, and of the extremities generally, are susceptible of such satisfactory treatment by compression and flexion, that the more dangerous method of injection would here be out of place. An exception, however, must be made for those varicose aneurisms seen most commonly at the elbow after venesection, which have not always proved amenable even to digital compression, and in which deligation is somewhat complicated and difficult. Injection of perchloride of iron has four times been successfully applied to such a condition by Jobert, Serres, Valette, and Dieulafoy; and proper precautions being used, this method may here be found advantageous. The same may also be said for cirsoid and anastomotic aneurism. (See Cirsoid Aneurism.)

When in any case it is determined to inject a coagulating fluid, it is desirable to adopt certain precautions. In the first place, as to the fluid selected. Various preparations of iron, such as the lactate, the persulphate, the acetate of the sesquioxide of iron, tannic acid, alcohol, and acetic acid, have been recommended and employed; but the coagulating power of the solution of the perchloride is so much greater than that of any of these fluids, that it obtains the preference, notwithstanding its irritating qualities. In order to reduce this irritating action to its minimum, it is desirable to employ a neutral solution of the perchloride, and one of feeble dilution. Very careful directions have been given for the preparation of the solutions by M. Burin-Dubuisson,[1] M. Soubeiran,[2] and others. In the earliest cases a solution was employed of the strength of 45° to 49° Beaumé, *i. e.*, sp. gr. 1.454 to 1.526; but experience has shown that solutions of this strength are productive of excessive inflammation, and lead almost inevitably to grave accidents. The experience of M. Valette has shown that a solution of twenty degrees possesses great coagulating power, and no higher degree of strength should be employed.

[1] Instituzioni Chirurgiche, pp. 68, 82, 124. Milan, 1813.

[2] Costello's Cycl. of Prac. Surg., i., 218.

[1] Compte rendu de l'Acad. des Sciences, Jan. 16, 1854, vol. xxxviii., p. 89.

[2] Bulletin de Thérapeutique, vol. xlv., p. 454, 1853; see also Thèse de M. Jean Pravaz, Paris, 1857.

Care also should be taken not to inject an excess of the perchloride; for this not only inflames the tissues of the sac, but diminishes the solidity of the clot. M. Broca advises the injection of twenty drops to every centilitre (100th of a pint) of the contents of the aneurismal sac. The recent experience of M. Dieulafoy (1859) seems to show that one-tenth of this quantity may suffice; and that for an aneurism containing twelve centilitres, or three and a half ounces, eighteen to twenty drops only need to be injected. The best instrument for the purpose is the small graduated syringe with screw piston and glass body, made for the purpose by most instrument-makers, and also used for subcutaneous injections. In performing the injection, it is necessary first to establish accurate compression of the artery above and below the tumor, so as completely to arrest the blood in it. The pointed trocar is plunged perpendicularly into the tumor, care being taken on the one hand to enter the cavity, and on the other not to transfix it, both of which accidents have happened to experienced operators. The success of the step is indicated by the issue of *arterial* blood, an indication which should be looked for. The canula is now screwed on to the trocar, and so much as may be thought necessary of the injection is pushed out into the fluid contents of the sac by successive turns of the piston. Each turn is usually equivalent to half a drop, and the quantity injected may be further estimated by a reference to a scale, which should be marked on the glass body of the syringe. The point of the trocar may be directed upwards, downwards, and on either side, without withdrawing it, so as to form several centres of coagulation. When the tumor has acquired a certain consistence and the coagulation has sufficiently taken place, one turn backward should be given to the piston, so as to draw up the liquid contained in the canula and to prevent its irritating contact with the tissues; it is then carefully withdrawn. The compression of the artery on the cardiac side of the sac should be continued for an hour.

It is necessary to attend to these precautions very carefully, because experience has shown that owing to their neglect many of those serious accidents occurred which marred the success of the earlier cases. Notwithstanding their observance, it is to be expected that inflammation of the sac, with its attending disasters, will frequently follow the injection of the perchloride of iron; and since this method is mainly applicable to those superficial aneurisms which can be treated by other proceedings not open to that objection, and not followed by those dangers, the applications of the treatment by injection are likely to be limited.[1] The discovery of a fluid of great coagulating power, and devoid of irritating properties, is a desideratum in this method.

[The Index-Catalogue of the Library of the Surgeon-General's Office, U. S. A., contains no reference to the use of this method since 1870, and I infer, therefore, that it has been rarely employed during the last ten years. Dr. Hutchison, of Brooklyn, has used it twice during this period: once in July, 1876, in a case reported by Prof. Van Buren (Trans. International Med. Congress, Phila., 1876), of aneurism of the abdominal aorta in a sailor of 32, making three injections at intervals of two or three days of 30 minims of a solution containing about half a grain of the persulphate of iron. Death followed within a fortnight with symptoms of inflammation of the sac and subsequent rupture. The second case was one of recurrent femoral aneurism after ligature of the external iliac (Am. Journ. Med. Sc., Oct., 1880); between the 20th Oct. and the 2d Dec., 1879, he made nine injections of from 5 to 15 minims each of solutions of the persulphate in water varying in strength from 1 in 30 to 1 in 5; pressure was made above and below the aneurism; no beneficial result was obtained. In a case of aneurism of the innominate, for which Dr. Eliot tied the carotid and subclavian (Am. Journ. Med. Sc., April, 1877), ʒxss of a solution of persulphate of iron were injected on the seventeenth day after the operation to arrest hemorrhage from the sac. This was followed by a discharge of bloody serum for three days and protrusion of a dry clot, which fell out on the twenty-fourth day, leaving a cavity that would admit three fingers. Fatal hemorrhage occurred on the twenty-sixth day.]

Introduction of Wire into the Sac.

Mr. Moore has suggested[2] a method of inducing coagulation in the sac of an aneurism by means of the introduction of a large quantity of fine iron wire. The object of this proceeding is to detain the fibrin of the circulating blood, and thus to form a clot, much in the same way as in the common experiment of whipping the fibrin out of a mass of blood with twigs.

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[1] In Gurlt and Hirsch's Jahresbericht, vol. ii., p. 314, Berlin, 1869, will be found a reference to a work by Signor Marsacci on this method of treating aneurism; in which the author relates numerous experiments with all known kinds of coagulating fluids. The conclusion arrived at is that expressed in the text, viz., that the method is one not deserving of confidence, and which it is unjustifiable to employ in cases where compression can be used.

[2] Med.-Chir. Trans., xlvii., 129.

For this purpose Mr. Moore inserted into an aneurism of large size connected with the arch of the aorta, and which was on the point of bursting both into the pericardium and through the skin, twenty-six yards of fine iron-wire. The wire was inserted through a fine canula, the point of which was moved about during the performance of the operation (which lasted an hour), so as to coil up the wire all round the sac. The canula was provided with a probe made of stouter wire, rounded at the point, and large enough just to fill its tube. This is necessary, both to ascertain as nearly as possible the size and position of the aperture of the sac, and also to push the fine wire out of the canula into the cavity of the aneurism, for it is obvious that, if the wire were left projecting out of the sac, ulceration and fatal hemorrhage would probably ensue. Rapid coagulation was the consequence of the operation, the aneurism ceased for a time to pulsate, and the pulse-rate diminished from 116 to 78. But this favorable change was transitory: severe inflammation of the sac and parts around soon set in; pulsation and tension returned in the tumor, and the man died exhausted by pain on the fifth day after the operation. On post-mortem examination the proximate cause of death was found to be pericarditis, evidently induced in some manner by the inflammation set up in the large sac, which was in close proximity to the pericardium. There were also scattered abscesses in the kidneys, but whether these were produced by the impaction of clots carried down from the aneurism, seemed, to say the least, doubtful, since traces of a similar action at an earlier period were detected in those organs. The sac was bilocular, a larger pouch lying in front of the bones of the thorax, which had been eroded. This was filled with a firm and adherent coagulum inclosing the coils of wire. The smaller pouch had not been entered by the wire; but a clot projected into this and through it into the artery, part of which had probably formed after death, but a portion was decolorized and laminated. The opening from the inner sac into the aorta was hardly as large as a sixpence.[1]

I have thought it right to refer to this case somewhat at length as illustrating the latest of many propositions for the treatment of aneurism incurable by the ordinary methods; but I do not feel myself able to pronounce a decided opinion as to whether the proceeding is less or more dangerous, and less or more likely to succeed than galvano-puncture, which is the only other available method in such cases. It must be remembered, on the one hand, that it has only been tried once,[1] that a very large quantity, probably too large a quantity, of wire was used; and that a very considerable deposit of adherent fibrin was produced, accompanied by great temporary amelioration of the symptoms. These considerations might lead one to hope that in a future trial with additional precautions better success might be obtained. On the other hand, the history of the case shows unmistakably the great danger and uncertainty of the method, the difficulty of judging of the form of the sac, the position of the opening, the extent of coagulation to be produced, or the effects of its production.

Other surgeons have also tried to induce coagulation by introducing foreign bodies into the aneurismal sac. The operation has always been performed by means of needles, which have been withdrawn when the coagulation has seemed sufficiently far advanced. M. Richet mentions[2] five cases in which this plan has been adopted, but in no case with any success, and in some with very grave accidents. In another case cited by M. Richet a very small temporal aneurism was treated by inserting two needles and tying a ligature beneath them, as for nævus, and with success. This, however, is quite a different matter. M. Velpeau and Mr. B. Phillips, are also referred to by Mr. Moore as having performed experiments to prove that aneurism might be treated in this manner; but I do not find that either ever used acupuncture on the living body, except in combination with galvanism. In my opinion, as far as I am able to judge from the few cases recorded, galvano-puncture is a less hazardous measure, and more likely to prove successful, than acupuncture without galvanism.

[Velpeau showed by numerous experiments upon animals, and by an accidental operation upon the femoral artery of a man, that an artery could be permanently occluded in its continuity by transfixion with a needle left in place for two or three days. He reported his experiments to the Académie des Sciences in 1829, and the communications are published in the Gazette Médicale, Paris, vol. i., No. 48, 1880, and vol. ii., p. 1, 1881. The title is "Sur la piqure ou acupuncture des artères dans le traitement des anévrysmes." Galvanism was not used in connection with the puncture, and no mention is made of puncture of the sac itself.

I have found only the following cases of the introduction of a foreign body into an

[1] The coagulum which was formed around the wire is to be seen in the Museum of the Middlesex Hospital. It is almost as large as a cricket-ball, firm, and partially decolorized. A smaller piece of clot is also preserved which projected into the lesser sac and the opening of the artery.

[1] A very brief report of a case thus treated at Liverpool without success was published, I am informed, soon after Mr. Moore's.

[2] Richet, op cit., p. 324.

aneurism reported since the publication of this essay: On the 23d March, 1871, Dr. Domville (Lancet, 1871, ii., p. 287) introduced 14 inches of fine iron-wire through a canula $\frac{1}{16}$th inch in diameter into an aneurism of the aorta, that projected as a double tumor through the sternum. "Only a few drops of black treacly blood escaped." The tumor became firmer, but increased in size, and on the 9th April rupture was imminent. Nine needles, $2\frac{1}{2}$ inches long, were then passed in so as to cross one another under the apex of the tumor. Fatal hemorrhage occurred on the 23d April. At the autopsy there was found a sacculated aneurism of the aorta occupying the anterior mediastinum and communicating by an eroded opening through the sternum with the external tumor, in which latter lay the needles and the wire imbedded in a "dark fibrinous coagulum."

In April, 1872, Mr. Murray presented a patient before the Royal Med.-Chirurgical Society of London, and read an account, printed in vol. vii., p. 72, of their "Proceedings," of several cases treated by this means. The first case was a globular aneurism of the innominate and aorta bulging on the front of the chest; 18 or 20 needles were inserted and left in for 12 hours, and about four weeks afterwards the attempt was repeated with 24 to 30 needles left in for 24 hours. Each operation was followed by a certain amount of consolidation and no bad symptoms. Then 24 feet of wire was inserted through a canula, causing no discomfort. The patient continued to eat and sleep well for a fortnight; then, while drawing off his shirt, he felt something give way in the aneurism, suffered much pain in it, became feverish, and died. "The post mortem revealed a considerable amount of fibrin among the coils of wire, but towards the left side of it the clots were soft, friable, and watery."

In the second case, an aneurism of the arch of the aorta, needles were inserted twice. Erysipelas began at the punctures and caused death.

The third case was a large aneurism of the innominate and aorta. 20 feet of catgut was introduced with no apparent benefit. At the post mortem it was found washed into a saccular dilatation of the upper part of the aneurism, softened, and quite destitute of fibrinous coagula.

The fourth case, the one exhibited, was a saccular aneurism of the subclavian. Five or six trials of complete transfixion with 20 or 30 long needles for several hours were followed each time by consolidation, lessening of the size of the aneurism, and relief of pain. "The aneurism is much better in all respects, but the old man is 'sick of the needles,'" and will not have them re-introduced until he is worse again.

In Oct., 1873, Dr. Levis (Trans. Path. Soc. of Philadelphia, vol. v., p. 79) introduced 24 feet 9 inches of horse-hair through a fine needle canula without difficulty into an aneurism of the right subclavian. At the autopsy a few weeks afterwards, the horse-hair was found imbedded in a dense white clot in a secondary sac formed within the thorax by previous rupture of the aneurism.

In Nov., 1873, Mr. Bryant (Practice of Surgery, 3d Am. ed., p. 352) introduced 20 feet of horse-hair through a fine canula into a rapidly increasing popliteal aneurism, "with the effect of causing almost complete consolidation of the tumor." The patient, who had been admitted with ulcerative endocarditis, died five days afterwards.

In January, 1879, Mr. C. Heath (Brit. Med. Journal, 1880, i., p. 205, and Lancet, 1880, i., p. 168) introduced three pairs of fine sewing-needles, making each pair cross, into an aneurism of the left subclavian, for which he had amputated at the shoulder-joint two months previously. The needles were withdrawn on the fifth day, and the tumor became solid. The patient died of bronchitis Jan. 18th, and the aneurism, which had been caused by fracture of the first rib five months before, was found nearly full of dense fibrin and communicating with the subclavian by a very small opening.

In Oct., 1878, I introduced at the Workhouse Hospital, N. Y., with the assistance of Dr. Chas. McBurney, a loose bundle of carbolized horse-hair, consisting of about fifteen pieces each six inches long, into an iliofemoral aneurism, by transfixing the tumor with a long canula 2 mm. in diameter, fixing the centre of the bundle close against the end of the tube by a noose passed through it, and drawing it into the sac by withdrawing the canula and loosening the noose. Previous attempts to introduce catgut and horse-hair by passing it through the canula had failed in consequence of the clotting of the blood within the instrument. No permanent change resulted in the physical symptoms of the aneurism, and a month later, the patient's consent having been finally obtained, a ligature was placed upon the external iliac and cured the disease.

It does not appear that in any of these cases the pressure of the foreign body was injurious to the patient, and in one of them (Mr. Heath's) it seems to have effected a cure, although in the discussion that followed its presentation to the Med.-Chir. Society the opinion was expressed that the amputation at the shoulder probably had much to do with its success. The character of the aneurism, its communication with the artery by a very small opening, was exceptionally favorable to consolidation. In Mr. Bryant's case the patient survived so short a time that it cannot be known whether the consolidation would have become complete and permanent. Mr. Bryant thinks the method is justifiable "under circumstances in which all other plans of treatment are unjustifiable or have failed," an endorsement which is practically a condemnation. It is certain that but little good is to be expected from it, and, if it is to be tried, the temporary introduction of needles is probably to be preferred to the permanent lodgment of either catgut or horse-hair.]

Treatment by Galvano-Puncture.

In the preceding modes of treatment of aneurism it is proposed to effect a cure either by retarding the course of the blood, or by introducing elements which favor the precipitation of its plastic principle. [The latter portion of this sentence refers to the two previous sections: *Treatment by coagulating injections*, and *The introduction of wire into the sac.*] Galvano-puncture aims at producing such a modification of the contents of the sac as shall favor slow coagulation, without incurring the risk of introducing into the circulation foreign and perhaps injurious matters. This end it occasionally accomplishes; but it is not without its own peculiar accidents and dangers. Thus out of fifty cases of aneurism so treated, collected by Ciniselli,[1] twenty-three were cured, twenty were not cured, and in seven instances death resulted. Indeed, the first applications of electro-puncture made by Benjamin Phillips,[2] Liston, and Gérard, in 1838, and the subsequent essays of Mr. Keate,[3] were so little successful as to discourage further trials; and but for M. Pétrequin,[4] whose persevering application of this plan was, in 1845, followed by success, the procedure might not yet have found a place in practical surgery. Since the publication of those cases, repeated applications of this method have been made to all kinds of aneurism. But although these have served to show clearly the power of electricity to effect the cure of aneurisms, they have shown also very clearly the dangers and accidents to which it may give rise. It is a radical defect of this procedure that it acts by inducing direct (or "passive") coagulation of the blood in the sac. Hence it is inherently uncertain, liable to cause relapse by the melting of the coagulum, or inflammation by its too sudden deposition. Again, it is very liable to set up inflammation in the walls and contents of the sac. Then, too, the needles sometimes produce eschars at the points of their insertion, and thus give rise to consecutive hemorrhage. In Ciniselli's Table, referred to above, the result of the forty-three cases which survived the operation is thus stated: of the twenty-three cured, six were the subjects of grave accidents; seventeen recovered without or with slight accidents; of the twenty who were not cured, seven were the subjects of grave accidents, thirteen recovered without or with slight accidents. In fact, the cases are few in which a perfectly happy result has been obtained; but some of these are worthy of particular attention.

Thus a subclavian aneurism, forming a tumor as large as a hen's egg beyond the clavicle, was cured by this method by Dr. Abeille.[1] The success of this case alone, the size of the vessel affected, its proximity to the heart, the rapid increase of the tumor, and the coincidence of constitutional disease, would suffice to give importance to the method by which it was cured. Again, the successful application of galvano-puncture by Nélaton to cirsoid aneurism,[2] and to varicose aneurism at the elbow by Voillemier, afford instances of success in the treatment of varieties of the disease not very amenable to other modes of treatment. Two cases are recorded in which galvano-puncture has been employed with some success in the treatment of aneurism of the ascending aorta; in one with the result of producing what is described as "a very sensible and evident improvement,"[3] while in the other the improvement was so great that the patient appeared at any rate temporarily cured.

This latter case is so striking, and so well illustrates the method, that a short abstract of it will be offered. It is reported by Signor Ciniselli, in the Gaz. des Hôp., Nov. 17, 1868. The aneurism was of the ascending aorta on the right side, and was rapidly increasing; the third and fourth ribs, and the intercostal space between them, were much pushed outwards by the tumor; its pulsations were powerful, and very perceptible to the eye as well as to the touch. The patient could not lie on his back, was much troubled by loss of sleep, and quite unable to follow his occupation. At the same time the absence of alteration of the voice, and of obstruction to the jugular veins, with the limited extent over which pulsation could be felt, rendered it probable that the aneurism was not of any large size. Three polished steel needles were buried in the tumor, each penetrating the sac of the aneurism to about an inch in depth. The positive pole of the battery was first applied to each needle in succession, the negative pole being placed in contact with the skin over the tumor. This precaution is said by Ciniselli to prevent the formation of eschars.

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[1] Sulla Elettropuntura nella cura degli Aneurismi, by Dr. L. Ciniselli. Cremona, 1856.

[2] Experiments showing that Arteries may be obliterated without Ligature. See the work of Phillips, London, 1832; and his Letter claiming priority of invention, in the Archives gén. de Méd., 1847.

[3] Lancet, 1837–8, vol. ii., p. 668.

[4] Compte rendu de l'Acad. des Sciences, 1845, vol. xxi.

[1] Archives gén. de Méd., August, 1849.

[2] See infra, Cirsoid Aneurism. See also an interesting paper by Dr. Duncan, Edin. Med. Journ., April, 1866.

[3] Gaz. Medica di Milano, 1847, No. 2; Ibid., 1850, No. 33; Gaz. Medica Ital. Lombard., 1850, No. 44. Another case quoted here was unsuccessful.

The electric-current was procured from a pile formed of thirty square couples, each side measuring ten centimetres (about three inches), steeped in a solution of sea-salt. The current was directed down two of the needles for ten minutes each, and the other for five minutes, the whole proceeding lasting forty minutes. The withdrawal of the needles was followed by a little bleeding, easily checked by saturnine compresses and ice. The same means also reduced the redness and swelling, which was the only sign of local reaction. No general symptoms followed. The tumor rapidly diminished in prominence and in pulsation; the patient could lie on his back, and was able to sleep, almost immediately after the operation. The aneurismal bruit, which had been very loud, also gradually disappeared, and it seemed that the tumor had become solidified, though some pulsation could be still felt, which was thought to be that of the aorta transmitted through the solidified mass. He was kept quiet as long as possible; but ten weeks after the operation, feeling himself quite well, he resumed his occupation, that of a coachman.

From the study of numerous collected cases, it may be seen that the *modus operandi* of galvano-puncture in cases where cure has followed its application, has not always been identical. In some instances, the introduction of the needles into the sac and the application of the current has apparently been followed by the formation of a clot which only partially filled the aneurismal sac; and by virtue of the power which freshly deposited fibrin has of attracting to itself fresh layers of fibrin from the circulating blood, the clot has gradually increased in size, until the tumor was solidified and cure effected. This is the most favorable sequence, and may be regarded as the typical result. But this sequence is rare. In other cases, at the end of the sitting the sac is already filled with a more or less solid coagulum; sometimes this melts, sometimes it remains permanent and yields a cure. Most commonly, however, the introduction of the needles has been followed by symptoms of inflammation within the sac, and the cure has been due to the effect of this inflammation. Either coagulation has slowly followed upon the inflammatory action, or suppuration and obliteration of the sac has been induced. The pain of the operation is in most cases very considerable.

Dr. Althaus[1] has described a form of battery which is very portable and convenient for the removal of tumors, and the treatment of other forms of disease by electricity. By immersing only the needle connected with the negative pole of this apparatus in the sac, he believes "a foreign body may be safely deposited in the sac, round which we may expect a slow and gradual deposit of laminated fibrin to take place."

All these methods of cure must be considered as less satisfactory than those in which deposition of stratified fibrin is slowly obtained. The risk of exciting inflammation in the sac and its contents is a very serious hazard, and the statistics of this method practically confirm the objections which we may adduce simply from a knowledge of its mode of operation.

[Mr. Holmes has since said (Lancet, 1872, ii., p. 327): "But no one can have read the literature of this subject . . . without convincing himself that, by appropriate manipulation, coagula may be produced, in the part of the sac which is acted upon, without any grave inflammatory reaction, or any very serious risk of hemorrhage, of embolism, or of gangrene opening into the tumor." It has been shown in several cases of intra-thoracic aneurism that, even if the attempt to cure by this means fails in its main object, it will nevertheless probably produce an alleviation, more or less prolonged, of the distressing symptoms, that is a fair compensation for the risks incurred. Most writers recommend that several needles should be used and connected simultaneously or consecutively with the positive pole; that currents of high tension should be used; and that the application should be prolonged for an hour or two.

In a remarkable case, referred to by Holmes (loc. cit., p. 665), under the care of Dr. John Duncan, of Edinburgh, galvanism was successfully used to avert impending rupture of an aneurism of the thoracic aorta, the skin covering which was discolored and partly gangrenous over an area as large as a crown-piece. The current was passed for one hour and twenty-six minutes through two needles, one connected with the positive, the other with the negative pole. The tension of the sac was much increased at first, and bloody serum oozed through the gangrenous skin, but at the end of the sitting the pulsation was reduced to a gentle heaving motion. The tumor was then covered with cotton, which was left in place for a month; on its removal, "one-half the tumor was found flat to the chest, and the remainder greatly diminished in size. An ulcer in process of cicatrization, and not much larger than a shilling, was situated to the left of the sternum, half an inch from the area of pulsation." Three weeks later a second application of galvanism was made with similar results after arterial bleeding through the ulcer. The patient died about two months after the second attempt.]

[1] On the Electrolytic Treatment of Tumors and other Surgical Diseases, p. 12. Dr. Althaus differs from Ciniselli, believing that the negative pole only ought to be brought into contact with the blood in the sac. He gives no case of his own, but cites an instance in which an aneurism was thus cured—though by mistake, for the operator had intended to apply the positive pole.

Galvano-puncture appears, then, at present to deserve to rank only as an exceptional expedient. Its claims will have to be considered by the practical surgeon principally when he is called upon to treat either aneurisms at the root of the neck, or internal aneurisms which cannot be reached by digital or mechanical compression, and some forms of varicose and cirsoid aneurism seated superficially. The dangers and imperfections of the process must restrict its application even in this limited field. But as a resource available in cases where neither compression nor ligature can be advantageously applied, it has a sphere of useful action.[1]

Traumatic Aneurism.

By "traumatic aneurism" is meant a tumor containing blood, communicating with the cavity of an artery, and due to a wound of the vessel. Three descriptions of injury may lead to the formation of a traumatic aneurism: 1, a wound penetrating from the surface; 2, a tearing or strain of the coats of the vessel without wound; 3, fracture of a neighboring bone.

The first is the most common, or at least the most commonly recognized[2] cause of traumatic aneurism. A man receives a stab or a small incised wound. It bleeds freely, and most likely in jets; but the hemorrhage is restrained by firm pressure; the wound heals, and the man thinks himself cured. He is conscious, however, of some loss of power and some anomalous sensations in the limb, such as cold, numbness, tingling, and a feeling of weight; and later on he discovers that a pulsating tumor exists beneath the scar of the wound.

In such a simple case it is easy to see what has happened: the artery has been penetrated by a wound which was too large to be closed by the mere efforts of nature,[3] but which did not cut the tube across, and did not stop the circulation. The blood has not had a very direct exit by the skin-wound, probably in consequence of the altered position which fasciæ and other membranous structures assume in deep wounds, under varying conditions of pressure, tension, etc., and therefore the bleeding has not interfered with the healing of the opening in the skin. Meanwhile, below the fascia blood has continued to exude into the cellular tissue among the muscles, forming a large diffused ecchymosis. This ecchymosis may continue for some time to increase; such, however, is not necessarily the case, since as much of the blood may be withdrawn from the cellular tissue by the action of the absorbent vessels (the veins, and possibly the lymphatics), and by reflux into the artery during its diastole, as is poured out during the systole. Sooner or later, however, the presence of the blood acts as a source of irritation, and sets up inflammation in its neighborhood. This causes condensation, and then contraction of the areolar tissue, and so a sac is formed. By this time, probably a great part of the blood has coagulated, and so the aneurism (as it now is) contains a mixture of clotted and fluid blood, as most aneurisms do. In other cases the wounded part of the artery is believed to have yielded to the force of the circulation, and the sac is therefore formed by the tissue of the artery itself. The point is one of no practical importance. When traumatic aneurism is fully formed, the case differs in no respect from one of spontaneous aneurism, except, perhaps, in its greater proneness to cure, since the heart and arteries are probably healthy; while in spontaneous aneurism they are often diseased.

The symptoms of traumatic aneurism following an open wound are generally distinct enough. The scar of the wound will be discovered even if the history is obscure, and the pulsation and bruit are generally distinct. But it must not be forgotten, that before the sac has been formed, pulsation is often indistinguishable, though the bruit can almost always be recognized. Such lesions as these are often incorrectly spoken of as "aneurism;" a term which is only applicable when the sac has formed. This is not a theoretical or pedantic verbal distinction, but a practical difference of the greatest importance. The formation of a sac is the first step towards the cure of the disease, and shows that the case is amenable to the comparatively mild and indirect measures which are adequate for the cure of an aneurism, such as pressure on the main trunk, or its ligature at a convenient spot above the tumor, instead of requiring the frequently severe and difficult operation necessary for exposing and securing the wounded part of the vessel.

Traumatic aneurisms differ in rapidity and readiness of formation according to

[1] For a theoretical and experimental study of the mode in which galvano-puncture acts, and for a list of recorded cases, the reader may consult De l'électro-puncture dans la cure des anévrysmes intra-thoraciques, par L. Robin, Thèse de Paris, 1880.]

[2] If we consider the frequency with which popliteal and other surgical aneurisms are attributed to accident, and their much more frequent occurrence in persons and in situations most exposed to violence, we might be tempted to conclude that such aneurisms are usually traumatic, and due to the second of the class of causes above enumerated.

[3] See vol. i., pp. 468–470.

the nature of the tissue with which the wound communicates; whether the wound be in a large cavity filled with loose cellular tissue, or a space where the blood will be bound down and disposed in extensive membraniform layers by contiguous fasciæ or tense muscles. Thus in the axilla or orbit, traumatic aneurisms of large size soon follow an injury to the main artery, or even to a comparatively small branch. The well-known case of Lieutenant Seton was an example of this fact. A wound of a branch of the external iliac, the patient being stout and the cellular interval large and loose, occasioned an extravasation of blood, which was large enough to lead to the belief that the parent vessel had been injured. In the limbs, on the contrary, the formation of aneurisms in consequence of wounds of large vessels is more rare; and when formed, they will often undergo a process of spontaneous cure by rest and simple measures. The reason for this doubtless is, that before aneurism has formed, the blood itself, bound down by tense fasciæ and strong expanded layers of muscle, exercises pressure on the wounded vessel, tending to limit the effusion and close the wound; and after the tumor has been developed, the pressure which (it must never be forgotten) the sac exerts upon its contents is materially aided by the pressure of the soft parts upon the sac.

The progress of traumatic aneurisms, therefore, is not always towards death, even if left alone; and when they are of small size they are generally easily cured. Direct pressure is peculiarly applicable; but it should be carefully regulated and adjusted, so as to avoid the danger of sloughing. Perhaps digital pressure is the most efficient and safe, if circumstances allow us to secure the services of a relay of attendants, who will make gentle and steady pressure with their hands over the sac. Or in very small aneurisms lying against a bone, the patient may be directed to keep his finger on the pulsating part whenever he can. I have seen a small temporal aneurism, the result of the blow of a stone, thus treated with sufficient success to avoid the necessity of any other treatment. In larger and deeper tumors some form of bandage, with the intervention of an air-pad, may be necessary. Forced flexion of the limb is of course often advisable. With direct pressure may be combined the compression of the trunk leading to the swelling,[1] and the limb should be raised.

If these means fail, the artery must be tied. Some authors prefer in these cases the method of Anel to that of Hunter, arguing justly, that as the artery will be found healthy close to the tumor, one of the advantages which Hunter's method has over Anel's operation is lost.[1] This is quite true; but the general advantage of Anel's method over Hunter's, *cæteris paribus*, is very slight, since the mere fact of there being a portion of artery pervious between the ligature and the tumor hardly ever affects the progress of the case. If, therefore, the tumor be deeply seated, and it would be difficult to expose the vessel, as it leads into it, no hesitation need be entertained in trusting to the Hunterian method; while if (as is usually the case at the bend of the elbow) the tumor and the artery on which it is seated be superficial, the whole operation of opening the sac and tying both ends of the vessel offers no special difficulties, and is certain to succeed. It is therefore often adopted; and we shall see, when treating of axillary aneurism, that it has been recommended by a high authority for general use in that form of the disease. Still, the great majority of traumatic aneurisms have yielded to the proper application of pressure, and few of those which have not done so are known to have resisted the Hunterian operation. It is only in cases in which the tumor is superficially seated, and the operation therefore comparatively easy and bloodless, that the majority of surgeons would prefer the old operation.

Traumatic aneurisms from contusion or sprain, without external wound, are too closely allied to those of spontaneous origin to call for any special notice in this place. This form of injury is nearly related to the obstruction of the arteries, which is noticed in the essay on WOUNDS OF ARTERIES, vol. i., p. 462. The difference seems to consist in the complete or partial division of the coats of the vessel; the former leading to aneurism external to the artery, the latter to the formation of a coagulum and the obliteration of its tube. It is possible, however, that some aneurisms (and amongst others many of those called spontaneous) may arise from the laceration or paralysis from injury of the middle coat of an artery, and the protrusion of the blood through the space thus left into the cellular coat, which it distends.[2] The point is one of anatomical, rather than of practical interest.

Notwithstanding the remarkable immunity which arteries enjoy even in the most formidable injuries, it is not sur-

[1] See a case of traumatic aneurism of the radial artery, cured by a combination of forced flexion of the elbow and compression of the brachial, and afterwards by extension of the arm; Brit. Med. Journ., 1860, p. 859.

[1] It will be remembered that Anel operated for a traumatic aneurism at the bend of the elbow.

[2] See Rokitansky, op. cit., vol. iv., p. 299.

prising that, as they lie so close to the bones in many situations, they should occasionally be wounded by splinters, or ruptured from sudden stretching in fractures. This accident is not common; and it usually happens in such severe injuries that amputation is necessary: some cases, however, are left, in which laceration of an artery occurs as one of the complications of a simple fracture, or of a compound fracture in which the other injuries are not very grave. In the latter case, no great difficulty can exist in deciding on the necessary treatment. If the limb is to be saved, the wound must be enlarged, and the wound of the vessel treated irrespective of the fracture. But when a large bloodvessel is wounded in a simple fracture, it is not always easy to make out in the first place whether the wounded vessel is an artery or a vein, and if the former, whether the main artery of the limb or one of its branches. In deciding between an artery and a vein, the chief guide, of course, would be the presence or absence of pulsation in the collection of blood; but then pulsation is often not perceived at first—not till the blood has become encysted, and the case therefore has changed from a wound of the vessel to a traumatic aneurism. Another important symptom is the state of the pulse below the injury; but this may be obscured by the ecchymosis and other swelling. Again, bruit may be heard at the seat of the injury; and this, although it does not quite settle the point,[1] yet is perhaps the most accessible and trustworthy of all the symptoms.

Now, in such a case as this three courses are open: viz., to cut down on the seat of fracture and search for the bleeding vessel; to amputate the limb; or to leave the case to the powers of nature, aided of course by rest and suitable position.

In John Bell's Surgery this species of traumatic aneurism is very fully discussed; and he seems to have been of the opinion that it was always necessary, in cases not severe enough to demand amputation, to cut down and tie both ends of the vessel.[2] That this severe operation is, at any rate, not always necessary, is clear from the fact that four cases have occurred at the Middlesex Hospital, under the care of Mr. Moore and Mr. Mitchell Henry, in which such traumatic aneurisms have formed and have got well spontaneously. Short notes of one of these cases, which was under Mr. Moore's care, may be appended, as illustrating the subject better than a lengthened disquisition.

A woman, aged forty-two, presented herself in the middle of the day, having on the previous night fallen downstairs and injured her right arm. The whole of the hand and forearm and part of the upper arm were tensely swollen, and covered with bullæ of various but principally small size. Serum mixed with blood filled the bullæ. It was easy to make out a fracture of the olecranon; but it was impossible to perceive any fracture of the humerus, and the bones of the forearm appeared to be in place. She refused to come into the hospital, but was admitted next day. The swelling was then larger, and the vesications more extensive. There was an aneurismal pulsation in front of the elbow, strong and expanding, but deeply seated. The impulse extended halfway up the inner side of the arm, and more than halfway down the whole palmar surface of the forearm. A distinct bruit was heard with the stethoscope in front of the elbow. The two arteries at the wrist beat so forward and so forcibly, and appeared so much larger than those of the other side, as to give the idea that they had been raised by extravasated blood, and that the pulsation was communicated to the distended sheaths of the vessels. The skin of the hand was dusky from congestion; and when the color was driven away by pressure, it returned very slowly, showing the embarrassed condition of the circulation. The limb was every-

[1] A case occurred at King's College Hospital, in which, after injury, with protrusion of one eye, a bruit was distinctly heard over that side of the head. No hesitation was experienced in coming to the conclusion that the case was one of aneurism in the orbit, and the carotid was tied. The patient died; and after death no trace of aneurism could be perceived. The cause of the sound remained obscure. The case will be hereafter referred to under the head of Orbital Aneurism.

[2] "When an artery is thus lacerated, along with fractures of the bones, you have but this alternative, to cut the limb off at once, if it be very desperately wounded, or to try to save it, by making incisions and tying the artery. The fracture is already complicated with aneurism, and you are under the dangerous necessity of converting this complicated aneurism into a compound fracture. You apply your tourniquet, make a long and deep incision, turn out the coagula of blood with your fingers, cleanse the sac with sponges, search for the artery, and tie it up above and below where it is torn. You wash out the blood from the sac with syringes and sponges, for while it lies betwixt the bones they cannot unite; what blood you are forced to leave melts down into bad matter and flows off; the deeper parts of the wound gradually digest, granulate, and fill up with soft flesh; and when the continuity of the parts is thus restored, the new bone or callus begins to form. Such is the activity of a wounded artery in forming its aneurism and destroying the surrounding parts, and so complicated is the disorder when a wounded artery is added to a fractured bone, that unless these operations are performed early, the limb is inevitably lost."—John Bell's Surgery, Charles Bell's edit., 1826, vol. iv., p. 404.

where warm, however, and there was no sign of impending gangrene. A consultation was held, at which various opinions were expressed as to the appropriate treatment; but it was agreed that there could be no doubt that some large artery, possibly the brachial, was wounded. It was ultimately decided to watch the case. In the evening the swelling was found not to have increased, and the hand was certainly less tense. A rounded swelling was found near the armpit, in the neighborhood of the brachial artery, which appeared to be the end of the clot of blood. On the following day (the third from the accident) pulsation had ceased in all other parts, and was perceptible only in front of the elbow, over a space about as large as as a half-crown, and not strong. Next day the aneurismal pulsation finally disappeared, and the swelling afterwards gradually subsided. When the subsidence was sufficient, fracture of the lower end of the humerus was detected. The case did well.

Of the other three cases, one under Mr. Henry's care, was a wound of the posterior tibial artery, in a boy who suffered from simple fracture of the leg. The diagnosis rested upon the absence of pulse in the artery, and the presence of bruit, together with peculiar restlessness of the limb. The fracture healed slowly (in about two months), and the above symptoms gradually subsided; but the pulse did not return in the affected artery. In the third case (Mr. Moore's patient), one of simple fracture of the femur in a man aged thirty-five, there was extensive swelling, together with arterial bruit in some artery—not the femoral—which could be felt below the seat of injury. Here also the bruit and swelling disappeared with rest, and the fracture united in three months. The fourth case, also under Mr. Moore's care, was, like the second, a wound of one of the tibial arteries in fracture of the leg.

It will be noticed that the majority of these cases were merely wounds of the artery, and not aneurisms in the strict sense of that term; since they recovered without the formation of any aneurismal sac.[1] This fact seems to testify, even more strongly than the mere occurrence of spontaneous cure, to the decided tendency to recovery manifested by wounds of healthy arteries when uncomplicated by external injury.[1] But if an aneurismal sac should form, its formation, far from being an unfavorable feature in the progress of the case, is part of the process of cure. It seems abundantly clear, therefore, that surgical interference in these cases can only be justified by the presence of alarming symptoms; and that, by the aid of simple position, and perhaps in appropriate cases light and even compression, a great number of arteries wounded in fracture will heal.

The clot sometimes softens, and suppuration occurs; and this again may lead to the spontaneous cure of the injury. An interesting instance of this spontaneous ejection of the clot may be found in Ormerod's Clinical Collections, p. 143, after rupture of the femoral artery in a child, the patient recovering, with only the loss of two toes by gangrene; but the limb was useless.

There are, however, no doubt, cases in which things do not proceed so favorably; and this unfavorable course tends in one of two directions—either that no aneurism forms, but the extravasation of blood increases, and thus the circulation is so far disturbed that gangrene is either commencing or appears imminent; or that an aneurism has formed, and its increase calls for some operation to check it. If no aneurismal sac has been formed, and the extravasation of blood is increasing, gangrene will soon commence. The only way to prevent it would be to cut down, as recommended by John Bell, upon the wounded vessels; but the opportunity will rarely occur. When gangrene has absolutely set in, it appears theoretically possible that a similar practice might be occasionally advisable; but in all the cases of which I have knowledge, amputation or death has been the alternative. Still, the relief to the circulation afforded by the removal of the extravasated blood might, in some rare cases of injury to the upper extremity, determine the surgeon to cut down upon the seat of injury, as a last effort to save a portion at any rate of a hand in which gangrene had absolutely commenced. This is a matter which would depend entirely upon individual judgment, based upon the symptoms of the case in hand. In the second case, that in which an aneurism has formed and is advancing, the treatment differs in no respect from that of aneurism in other circumstances and from other causes.

[1] To these cases of lesion of arteries in fracture may be added a case mentioned by Mr. Skey, in a discussion at the Medical and Chirurgical Society, on a paper by Mr. Syme (see infra, Axillary Aneurism). The patient, a woman, was supposed to have met with a dislocation of the shoulder, which was thought to have been reduced. A very large aneurism formed in the axilla. The tumor was laid open. Great hemorrhage followed; but this was soon checked, and both ends of the vessel were tied. The woman died. It was found that the artery had been wounded by the sharp ends of a fracture of the neck of the humerus.

[1] I would remind the reader of the many instances in which arteries have been wounded in subcutaneous section of tendons, and the rarity of consequent mischief.

The two cases related by Dupuytren[1] are well known: one occurred in his own practice; one under the care of Delpech. In both, some artery at the back of the leg (the popliteal, or one of its branches near the division) had been torn in a comminuted fracture of the bones of the leg; a pulsating swelling formed in the ham; and the surgeon, unwilling to amputate the thigh, fearing to lay open so large a cavity and inflict such extensive injury upon the seat of fracture, and being unaware of the reparative power of nature in such cases, cut down on the femoral artery and tied it. Both patients recovered, without a bad symptom.

These cases are interesting and will repay perusal. They bear a striking resemblance to Mr. Moore's case quoted above (p. 383); and it seems very probable that, if they had been similarly treated, they might have undergone a spontaneous cure, in the same manner as that and the other cases there referred to did. In neither of the cases related in the Leçons orales was there an aneurism, properly speaking, since sufficient time had not elapsed for the formation of a sac; but the clearness of the pulsation renders it probable that the ecchymosis was tending to become limited, and that a sac would soon form; and this appears to furnish an additional reason for waiting and watching the result. When aneurism has formed, it is a sign that the cellular tissue is contracting upon the blood. This is very likely to lead to deposit of laminated coagulum in the sac. At any rate, it is highly improbable that the aneurism will begin to increase rapidly, since the patient is of course at rest and the limb in an appropriate position. Should it, however, increase, compression of the artery above will be the method most probably indicated, perhaps with gentle compression on the sac, if the fracture is sufficiently consolidated. If the fracture be firmly united, it may even be advisable to resort to forcible flexion. In cases, however, where a main artery is wounded, as well as in those where it is tied, the fracture unites very slowly. This may be noticed in the cases from Middlesex Hospital, quoted above, and has been observed by Dupuytren and others; so that the treatment of traumatic aneurism from fracture, if it increase while the patient is lying in bed, will be by compression or ligature of the main trunk: and in cases so far resembling Mr. Spence's, quoted on p. 371, that the aneurism has apparently consolidated during the repose necessitated by the fracture, but recurs on the patient resuming his active avocations, the treatment there pursued (that of forcible flexion) will very probably be as successful as it was in that case, should the situation of the tumor render it applicable.

Aneurisms the result of fracture are not confined only to the arteries of the limbs, but may form in any part where an artery lies sufficiently near to a bone to be involved in the injury. Thus Mr. Busk and Mr. Curling have each put upon record a case in which a traumatic aneurism formed upon the ophthalmic artery as a consequence of fracture of the base of the skull.[1] In both cases the carotid artery was tied, and with complete success. (See below on Orbital Aneurism.)

Rupture of arteries.—The complete subcutaneous rupture of an artery from a blow, strain, or wrench, and the consequent extravasation of blood into the cellular membrane, is the form of injury which is usually, though incorrectly, called a "diffused traumatic aneurism." It should be called what it is, viz., "rupture" or "laceration" of the vessel. The injury is more commonly seen in the popliteal than in any other vessel, and next in the axillary, from obvious causes. The symptoms are, failure of the pulse below the seat of injury, great swelling of the limb from effusion of blood beneath the fascia, and remarkable loss of temperature. Pulsation cannot be detected unless the collection of blood is becoming encysted (*i. e.*, the case is passing on to the formation of aneurism)—at least this has been the case in all the instances of this injury which I have seen. Bruit can usually be heard, but this symptom is variable. I regard the loss of temperature as a most valuable sign of the injury. In some cases the rupture may be at first only partial, and then some pulsation may be detected in the vessels below the injured part.[2] Mr. Poland[3] believes that in such cases pulsation is more likely to be found in the collection of extravasated blood than when the artery is completely ruptured.

The treatment of this injury must depend on the vessel involved. When the symptoms of rupture of the popliteal artery have been well marked, I have never seen a case in which ultimately amputation or death has not followed, nor

[1] "Sur les Anévrismes qui compliquent les Fractures," etc., Leçons orales, tome ii., p. 521, etc. Paris, 1839.

[1] Med.-Chir. Trans., vols. xxii., xxxvii. See also the first of Mr. Nunneley's cases in vol. xlii.

[2] See a case under Mr. Brodhurst's care reported in the Path. Trans., vol. xvii., p. 74. Here the rupture seems to have been rendered almost complete by the exertion of taking a long walk. See also a case under Mr. Cæsar Hawkins's care, in "Poland," op. cit., p. 24.

[3] "On Rupture of the Popliteal Artery," etc., from Guy's Hospital Reports, p. 32.

can I find any recorded case which is to my mind satisfactory. Hence I think the best course is to amputate at once, when the loss of pulsation and the fall of temperature indicate plainly that the artery is completely torn across. In smaller arteries, and in those of the upper extremity, even as large a vessel as the axillary, the proper course is to cut down upon and secure the vessel. When partial rupture is suspected, a trial may be given to compression of the trunk leading to the injured part.

The accompanying vein is often also ruptured, especially when the artery is torn completely across. I am not aware that any symptoms exist by which this complication can be distinctly recognized; but its known frequency constitutes an additional motive for amputation in such cases. Sometimes the popliteal nerve has also been torn.

Arterio-Venous Aneurism.

Under this title are included two forms of aneurismal dilatation of an artery, communicating with a vein, known respectively as varicose aneurism and aneurismal varix.[1]

Varicose aneurism consists of a circumscribed consecutive aneurism, which communicates with the artery on one side and the vein on the other. The vein is always tortuous and dilated, sometimes to an enormous extent. In aneurismal varix there is no aneurismal sac. Adhesion has occurred between the artery and the vein at the point at which they communicate; and the blood is projected directly from the artery into the vein at each pulsation. Here also the veins connected with the diseased part are greatly dilated, and the embarrassment of the circulation thus produced is the chief symptom of the affection.

The usual condition of a varicose aneurism is shown in the accompanying figure, drawn from a preparation in the Museum of University College. Another interesting peculiarity is also to be noticed in this preparation—viz., that there is a high division of the brachial artery, and that therefore a ligature placed upon what was supposed to be the brachial artery might have failed to cure the disease, being applied to the wrong vessel. Even if the right vessel alone had been tied, the other branch of the brachial anastomoses so freely just below the sac, that it might have prevented the formation of a clot. The hour-glass shape of the sac is attributed, in the Museum Catalogue, to constriction by the fascia of the arm.

Fig. 324.

Drawing, from a preparation by Mr. Shaw,[1] of varicose aneurism at the bend of the elbow, in the Museum of University College, London. There is a high division of the brachial. The artery on which the aneurism is seated is the radial, which communicates very freely with the ulnar by a large transverse branch just below the sac. A probe has been passed from an opening in the skin (probably the puncture of the phlebotomy) through the vein and aneurism into the artery.—*a*. The basilic vein. *b*. The brachial artery dividing above the usual level. *c*. The radial, on which the aneurism is seated, and which has been tied a little above this point. *d*. The ulnar, anastomosing freely with the radial just below the aneurism. *e*. The arterio-venous aneurism, constricted at this part by the bicipital fascia. *f*. The probe passed through the puncture, made in phlebotomy, and from which hemorrhage occurred during life. [The ulnar artery was tied, as well as the radial, during the patient's life. Mortification of the arm ensued, of which the patient died.]

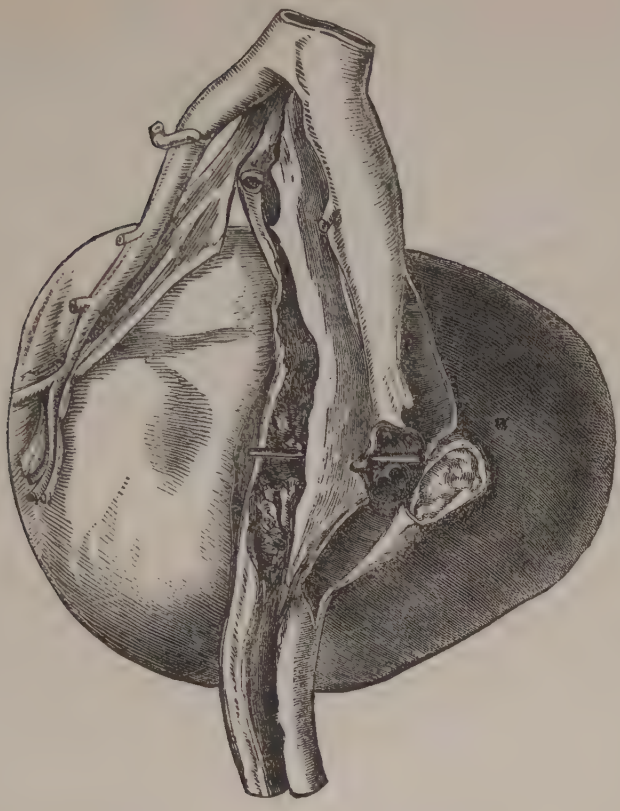
Another and very unusual form of arterio-venous aneurism is shown in the accompanying figure, which is drawn from a preparation presented by Mr. Beaumont, of Toronto, to the Royal College of Surgeons. The patient died under chloroform, administered for the operation of tying the external iliac artery.[2] In this singular case, the communication between the artery and the vein appears to have persisted for ten and a half years (as evi-

[1] William Hunter was the first to describe arterio-venous aneurism accurately; and he also pointed out the difference between an aneurismal varix and a varicose aneurism, though he did not use those terms. See South's "Chelius," vol. ii., p. 272.

[1] See Sir C. Bell's "Practical Essays," Part ii., p. 65. Edinb., 1842.

[2] Medical Times and Gazette, July 27, 1867.

Fig. 325.



denced by a continuous bruit, audible both to the patient and those near him), but the aneurism only formed at the end of this long period, whilst the patient was on horseback. The vein is here obliterated both above and below the aneurism; but there is a large opening between the vein and the artery. The usual signs of arterio-venous aneurism were absent, there being no venous murmur in the tumor, in consequence of the obliteration of the vein. In such a case, the Hunterian operation, which Mr. Beaumont contemplated, would no doubt have cured the disease, had the patient avoided the risk of gangrene, to which he was peculiarly exposed from the occlusion of the vein, and the pressure exerted by the tumor on the profunda artery.[1]

Both varicose aneurism and aneurismal varix may originate spontaneously, though they are more commonly the result of an injury in which the artery and vein have both been wounded. By far the most frequent cause is the unskilful performance of venesection at the bend of the elbow. Hence the affection is rarely seen now, when the operation is not often performed, and only by surgeons. Any other punctured wound, however, may give rise to the disease, as the wound of a small shot, or the fragment of a comminuted fracture; and so, it is said, may a simple contusion.[1]

In spontaneous arterio-venous aneurism, the communication with the vein apparently follows upon the development of a simple arterial aneurism in the con-

[1] An interesting case of a wound of the profunda femoris and its accompanying vein, treated by ligature of the external iliac, with a fatal result, will be found in the Gaz. hebd., 1864, p. 166.

[1] It is perhaps worth notice that the communication may occur between two vessels which are not naturally in contact, but which have been brought together by the force which inflicted the wound. Thus in the Museum of St. Bartholomew's Hospital, there is an interesting preparation (ser. xiii., No. 121), in which a small sac is formed communicating with the internal jugular vein and the external carotid artery. The cause was a punctured wound from the point of a pickaxe, and a small fragment of the iron has lodged and is impacted, partly without and partly within the cavity of the vein.

tiguity of a vein. When an aneurism is formed on a large artery, in such a part of the artery as to compress a neighboring vein, it is common to find that vein obliterated; and in the museum of every hospital there may be seen preparations showing the obliteration thus effected of the largest veins, the venæ cavæ being frequently so occluded. But occasionally, in lieu of effecting the closure of the venous channel, the pressure of the aneurismal pouch of the artery gives rise to absorptive ulceration of the coats of the vein, and the sac opens either by rupture or by ulceration into that vein. This happens especially within the thoracic and abdominal cavities, when aortic aneurisms press upon the great venous trunks of the chest and abdomen.[1]

Less frequently, arterio-venous aneurisms arise in the same way on the limbs, and on other parts of the trunk. Sometimes these occur long after the infliction of a wound which had affected the artery, but which had been perhaps almost forgotten.

Thus Rokitansky observed an axillary aneurism of this kind thirty years after a shot had taken effect on the spot. Roux[2] relates a case in which arterio-venous aneurism at the elbow formed four years after venesection; and Monneret[3] has described an aneurismal communication between the femoral artery and the vein, said to have arisen twelve years after injury from a shot. This was also the case with Mr. Beaumont's patient, p. 386.

[In Mr. Pemberton's case (Med.-Chirurg. Trans., vol. xliv., p. 189) an arterio-venous aneurism formed in the groin ten months after prolonged instrumental pressure had been made at that point in a successful attempt to cure a popliteal aneurism.]

Again, spontaneous arterio-venous aneurism has been described by Bransby Cooper,[4] by Perry,[5] and Porter,[6] affecting the femoral vessels in cases where the aneurism could not be traced to any other cause than primitive disease and thinning of the coats of the vessels. In the highly interesting case related by Mr. Perry, there was more than one communication.

It is usually a main artery, and its collateral vein, which are thus affected; and it may be readily understood that, from their close contiguity and often superficial position, these would be more likely to become the subjects of this diseased connection; but the elaborate investigation of MM. Follin and Charnal,[1] and the cases of Puydebat[2] and Pancoast[3] have shown that deeply-seated veins, as well as superficial veins, may be thus affected.

In the case of M. Follin, a communication between the brachial artery and a deep vein was diagnosed during life, and subsequently proved by the dissection of M. Charnal. Schottin[4] has seen a similar connection between the radial artery and the cephalic vein. Moore[5] relates a case in which an arterio-venous aneurism was found in the trunk of the popliteal nerve, as a result of a blow on the part, which appears to have produced rupture of a small artery and its companion vein in the substance of the nerve.

These two forms of arterio-venous aneurism have some symptoms in common due to the communication between the artery and vein. The most characteristic is a vibratory thrill, which results from the impulsion of the arterial blood into the patent aperture of the vein, there to mingle with the venous current. The greater tension of the arterial than the venous wall, and the greater force of the arterial flow of blood, causes a continuous injection of arterial blood into the venous tumor; but the pulsation of the artery produces a synchronous impulse in the flow of the blood through the tumor. Hence the peculiar vibratory or pulsatory character of the thrill, which is otherwise continuous. The ear detects a harsh, buzzing sound, which has been variously compared to that of a saw, a file, a bee, the hissing of burning metal plunged into cold water, and similar noises. This sound too is continuous, although momentarily increased during pulsation. It grows fainter on being propagated along the artery, and at some distance from the aneurism in which it arises it seems intermittent, the louder pulsatory sound only being then heard. This sound may be so loud as to be audible by a person standing near the patient; but that is exceptional. It may, however, always be distinctly heard with the stethoscope, or by the naked ear; and its continuous character sharply distinguishes an arterio-venous from a pure arterial aneurism. Considerable dilatation of the veins, a third symp-

[1] The earliest and most complete monograph on these forms of aneurism is due to Thurnam, Med.-Chir. Trans., vol. xxiii. See also Rokitansky, Ueber einige der wichtigsten Krankheiten der Arterien, Wien, 1852, pp. 46 et seq.; Porter, on "Arterial Disease," in Todd's Cyclopædia of Anatomy; Nélaton's Clinical Lectures, by Atlee; Mayn, Dublin Med. Journal, 1854.

[2] Bulletin de l'Acad. de Méd., Paris, 1849.

[3] Bulletin de Méd. et de Chir., 1852.

[4] Guy's Hospital Reports, vol. v.

[5] Med.-Chir. Trans., vol. xx.

[6] Todd's Cyclop., "Arteries," p. 242.

[1] Bulletin de la Soc. de Chir., vols. iii., v.

[2] Bulletin de la Soc. Anat., 1834.

[3] Fergusson's Handbook of Surgery, 1852.

[4] Schottin, Merkwürdiger Fall einer aneurismatischen Venengeschwulst, Altenburg, 1825.

[5] Med.-Chir. Trans., xlix., p. 29.

tom, is consequent upon the obstruction of the venous circulation by the entrance of arterial blood flowing in an opposite direction, and upon the general increase thus made to the quantity of blood which the vein must carry towards the heart. The extent of this dilatation varies according to the size and importance of the vessels affected. It is most marked in the lower limbs, where gravity aids in increasing the obstruction and consequent tendency to varicosity. Here the veins have been described like knotted ropes beneath the skin by Porter, Perry, Laugier, and others. In Mr. Moore's case, where the temporal vessels were affected, the veins were enormously dilated, and pulsated so strongly as entirely to simulate arteries during the operation performed.[1]

This pulsation of the veins is a fourth important symptom which deserves to be borne in mind; because the surgeon may be, and has been, induced by it to place a ligature round one of the veins, thinking it to be an artery. William Hunter noticed that the arteries below the point of communication beat more feebly than in the healthy body; and naturally, since a part of their ordinary supply of blood is directed into the vein. But this symptom is not always observed. The temperature of the part, and the growth of hair on the skin, are sometimes augmented below the communication. In old-standing cases, a remarkable condition of dilatation is observed in the arteries above the varix. They become enlarged, tortuous, and thinned in structure. Indeed, the veins around the arterio-venous aneurism assume more or less of the arterial character, and the arteries approach somewhat the type of veins. This has been observed by all who have described these cases, and is well summarized by Rokitansky in his monograph on the pathology of the arteries.

The varicose aneurism differs from the aneurismal varix, as we have seen, in that it possesses an aneurismal pouch which is intermediate between the opening of artery and vein. It is, of course, important in practice to recognize this difference, and mark its peculiar symptoms. This circumscribed aneurismal tumor will be found of various size and density, according to the site and duration. It rarely attains, however, any considerable size. It is affected in the same way as pure arterial aneurisms when the artery is compressed above or below it, and the ear detects the blowing sound of an aneurism, in addition to that rasping bruit described as the result of the venous communication.

In both forms of arterio-venous aneurism it may be said that we find a soft, fluctuating, knotted, and imperfectly circumscribed subcutaneous tumor. It can be emptied by pressure upon the tumor itself, or the artery leading to it. It has distinct pulsations; but these are limited to a very small part of the swelling at the level of the point of communication between the vessels, gradually becoming extinct in the ratio of distance from that point. In this it is distinguished from arterial varix or cirsoid aneurism, which offers pulsation of equal intensity over the whole extent of the tumor; it may be further distinguished from that affection by the blue or purple color of the tumor, and by the tortuous dilatation of the veins leading to it. Further, to distinguish it from arterial varix, to which it presents so many points of external resemblance, it may be added that while in both auscultation detects a loud rasping, continuous bruit, this sound is heard over the whole surface of the arterial varix, but only at the point of communication in the arterio-venous aneurism, or, if it radiates therefrom, it can then only be traced along the course of the artery, and becomes gradually extinct.

Treatment of aneurismal varix. — The treatment of aneurismal varix and varicose aneurism must be mentioned separately; that of aneurismal varix presents great difficulties. In many cases, indeed, the disease manifests but little tendency to advance; and where this stationary condition exists, surgical interference may well be omitted. In Mr. Moore's case, thirty-six years had elapsed before any operation was necessary; and Hunter, Cleghorn, Porter, and indeed all other authorities on this subject, have seen this occur. It is especially the case in the upper extremity. In the lower limb, however, the disease may extend so greatly as to destroy the use of the limb, or to threaten the destruction of the patient's life by hemorrhage. In the case referred to, as related by Mr. Perry, the Hunterian ligature was twice performed, but without effecting the cure of the disease. In a case mentioned by Mr. Bransby Cooper, it was considered necessary to amputate the leg. Should the surgeon now be called upon to treat, by operative means, an artery so affected in either of the extremities, he would probably attempt to obtain the closure of the arterial aperture by indirect pressure on the artery above the communication. The use of direct pressure has rarely been of any good effect. There are, however, two proceedings which are more promising: the injection of coagulating fluids at the site of the disease, applied carefully, with the minute precautions necessary for the success of that plan; or ligature of the artery above and below its aperture of

[1] Med.-Chir. Trans., vol. xli., p. 1.

communication. Before employing either method, it would probably be desirable to resort to digital or instrumental compression, or, if the position allowed, to forcible flexion. But the constant passage of the arterial blood through the apertures, resulting from the arterio-venous communication, and the absence of any defined sac, impede the formation of the fibrinous deposit to which these methods owe their success; and cases of aneurismal varix of this form are not very amenable to treatment by indirect compression. An interesting case is recorded in the Proceedings of the Anatomical Society of Paris, for 1858, in which indirect compression having been carefully tried, but without success, a ligature was applied by M. Robert above and below the aperture in the artery. [Prof. Czerny (Archiv für klinische Chirurgie, vol. xxv., p. 943, 1880) treated an aneurismal varix of the temporal artery and vein in a man of 30, the result of a wound made by a penknife twenty-five years before, by excising the communicating portions of the artery and vein after having placed two ligatures on each vessel, one above, the other below, the opening. The wound healed rapidly.] A few cases have been recorded of aneurismal varix within the skull.[1] In one of these, recently, compression was applied over the carotid, but ineffectually; in this case, the internal carotid artery communicated with the cavernous sinus; and death occurred as the result of profuse hemorrhage from the nose. In such cases, of course, only the Hunterian ligature is possible; but where the artery is more accessible, it is obviously more desirable to apply a ligature above and below the diseased communication.

The treatment of varicose aneurism is somewhat different in kind; for here a sac intervenes between the artery and the vein, but it is similar in principle. Here also direct and indirect compression have been largely tried. In general such trials have not been very successful. M. Nélaton, however, has succeeded four times in converting a varicose aneurism at the bend of the elbow into a simple arterial aneurism by direct pressure. Cure was then in all cases effected either by ligature, or by compression of the brachial artery.[2] Digital compression might be employed in the simpler cases, not without hope of cure.

Should it be necessary to apply the ligature, it is requisite to reject the method of Hunter in favor of the ancient proceeding. The most simple plan is to lay open the sac, trace it into the artery, and having exposed the aperture in the artery, for which purpose it is commonly necessary to divide the sac transversely on a director, then to apply a ligature above and below the arterial opening. This method is more simple than that which has been employed by Roux and Fergusson, who have endeavored to isolate the artery, and tie it above and below without opening the sac at all.[1] This is the more difficult, that the artery below its point of communication is small, and surrounded by veins dilated and closely packed. On the other hand, it is free from the objection attaching to the plan first described, arising out of the danger of putting two ligatures close to the sac, and at a point where it is surrounded by dilated veins. In any case the operation is peculiarly liable to one of two secondary accidents, hemorrhage and gangrene; hemorrhage from the part of the artery above the sac where it is dilated, thinned, and gives rise to numerous collateral branches; and gangrene of the limb below, which perhaps already, before the operation, was cold, benumbed, and œdematous. The injection of a weak solution of perchloride of iron has been employed by Serres and Jobert,[2] Velpeau,[3] and Valette,[4] twice with perfect success; once producing suppuration of the sac, followed by cure, and once, by M. Velpeau, ineffectually. These facts are in favor of this method of treatment; and as the safeguards against the accident of suppuration are more carefully studied, this plan may recommend itself still more strongly to the surgeon.

Galvano-puncture has been employed by Bosse and Capeletti. In Bosse's case two steel needles, connected with thirty-two pairs of galvanic plates, were introduced into the aneurismal tumor, and retained there for eighteen minutes. The cure was completed within ten days. In Capeletti's case the needle was introduced twice; suppuration followed and ultimately a cure. M. Debout has also recorded a successful case.[5]

There will be cases in which an expectant treatment will be most advisable, and others in which amputation might be the only available measure.

[1] Bulletin de la Société anatomique, vol. xxix., 1859, p. 298, and vol. xxx., p. 178.

[2] Journ. de Méd. et Chir., prat. 1862, p. 155.

[1] This operation was recently performed successfully by Prof. Spence in a case of arterio-venous aneurism of the femoral artery. Edin. Med. Journ., July, 1869.

[2] Bulletin de l'Acad. de Med., 1854.

[3] "Traitement de l'anévrisme artério-veineux," Bulletin de l'Académie de Médecine, 1854.

[4] Acad. de Méd., Paris, May 23, 1859.

[5] See Wernher, iii., 821; Ciniselli, sulla Elettropuntura nella cura degli Aneurismi: Cremona, 1856. Debout, Bulletin de Thérapeutique, 1847, p. 123.

Thus a case is reported in the Journal de Méd. et de Chir., pratiques for 1862, p. 155, under M. Nélaton's care, in which a man was suffering from an arterio-venous aneurism of considerable size in the ham, the result of a punctured wound of the popliteal artery. M. Nélaton recommended that no operative measures should be adopted, believing that the aperture of the aneurism into the vein was sufficiently free to render the bursting of the tumor improbable; and he remarked that the only efficient measure for the radical cure of the disease would be the old operation for aneurism, and this under the circumstances he held to be so difficult and dangerous that if driven to operate, he should prefer amputation.

[In the winter of 1879–80, Dr. Keyes operated at Bellevue Hospital, New York, upon a case of varicose aneurism of the upper part of the calf in a youth of twenty, caused by a pistol-shot two years before. He laid open the sac and tied the artery above; the portion of the artery below the aneurism was occluded. After the removal of the tourniquet, free bleeding took place from the lower part of the sac, apparently through the dilated anterior and posterior tibial veins, and was controlled with much difficulty by ligatures and pressure. The patient died on the third day, of acute septicæmia. The artery above the sac was not dilated or thinned, and the impression left upon me by the case was that ligation of the artery without opening of the sac was to be preferred, to be followed, if necessary, by galvano-puncture or the injection of a coagulating solution.]

Cirsoid Aneurism, and Aneurism by Anastomosis.

By cirsoid aneurism is understood a form of disease which consists in a simultaneous elongation and dilatation of an artery. The structure of its wall exhibits in the beginning no alteration, although the coats become thinned during the progress of the enlargement. It will be observed that this lesion is not strictly included in the terms of the definition which was given of aneurism, and recent authors have agreed that this disease is improperly denominated aneurism. But it seems practically most convenient to describe it here.

It is especially the middle coat of the

Fig. 326.

Cirsoid aneurism of the scalp. (From a drawing in the Museum of St. George's Hospital.)

artery which is affected when the process of thinning commences. This structure becomes pale, soft, and thin, so that the arteries look like thin veins. The dilatation is commonly equal throughout the circumference of the artery; but in the more severe cases the artery is greatly dilated, and presents unequal saccular pouches, which are in fact, so many true aneurisms, projecting usually towards the surface of the skin. As the artery elongates, it becomes tortuous and serpentine;

sometimes even spiral. The disease is rarely circumscribed, but attacks commonly several trunks and their branches. M. Broca, however, has described a case of perfectly circumscribed cirsoid aneurism of the scalp, treated successfully by the injection of perchloride of iron.[1] It may occur in the arteries of the extremity, and Cruveilhier has reported a remarkable case of cirsoid aneurism of the external iliac artery.[2] But it is more especially frequent in the arteries of the scalp, and in this situation more instances have been recorded than in all other parts of the body taken together. Originating usually in one of the arteries of the scalp, it extends itself to the branches of the other side of the head, and may implicate the connecting vessels to a variable extent. On the one hand, it may pass into the capillaries, widely dilating them, and affecting even the terminal veins in its march; or on the other, but in a smaller degree, it may affect by retrogression the larger branches from which the arteries of the scalp arises, passing even into the carotids. It is thus that it changes somewhat its anatomical characters. The venous capillaries and trunks become affected by the extension of the disease, and the arterial network becoming highly and morbidly developed, this form is known by the name of *aneurism by anastomosis*. The pathological condition and the principles of treatment are essentially the same; but when the disease is seated in the larger arterial trunks, it is commonly known as cirsoid aneurism; when it extends into the network of capillaries, it is known as aneurism by anastomosis, or racemose aneurism. It attacks most frequently the superficial temporal, the posterior auricular, and the occipital arteries. Commonly the surrounding tissues suffer but little injury; but sometimes the subcutaneous cellular tissue may be atrophied, and the skin dangerously thinned; at other times the soft parts may be thickened and indurated; sometimes the bones are grooved or even perforated.

M. Gosselin[3] has endeavored to subdivide cirsoid aneurisms into three classes: arterial varix, when large arteries are affected (as in Cruveilhier's case); cirsoid arterial tumor, when the smaller arteries are affected, forming a circumscribed lobulated pulsatile tumor; and aneurism by anastomosis, when the capillaries and skin are involved. The distinction is a real one in many cases, and useful to recollect, having an important bearing on practice; but the three forms are too much mixed together to enable us to accept it as a classification of the disease. The second class are those in which coagulating injections, according to M. Gosselin, are likely to succeed; and I would add that in the third class galvano-caustic or extirpation are the methods usually indicated.

The causes which give rise to cirsoid aneurism are not apparent. Occasionally its origin has been referred to a blow, or to an injury of a congenital erectile tumor; more often no cause can be assigned, and it is not evident why the scalp should be the chosen seat of this disease. [Lefort (Dict. Encyclopédique des Sc. Med., Art. Cirsoides) notes two principal apparent causes in the cases he collected, traumatism and pre-existing erectile tumor or nævus, but declares himself at a loss to explain the action of either.] It may be noticed here that the majority of cases occur in persons whose age varies from fifteen to thirty. The diagnosis of the disease can hardly be a source of difficulty, for the serpentine and pulsating character of the tumor afford a distinguishing sign. The manner of diagnosing this affection from varicose aneurism or aneurismal varix has been mentioned in the last section. But where it is associated with dilatation of the veins, some difficulty may arise in distinguishing it from the so-called erectile tumor, or teleangeiectasis, from which it is, however, still distinguished by its pulsations. Such cases have been recorded by Pelletan,[1] by Dupuytren,[2] and others.

The treatment of this disease commonly offers great difficulties and many risks. The frequency with which direct failure has followed various procedures, the yet greater frequency of relapse, and the occasionally fatal termination of operations which have been undertaken, are reasons for caution in dealing with this disease. Unless there is reason to fear that by its extension or by its severity it may prove fatal to life, it is commonly the more prudent course to abstain from operative interference. Cirsoid anastomosing aneurism is not always a source of imminent danger, and it may exist for many years without any other evil effect than that of inconvenience; and, indeed, in some of the least unfortunate cases it has so continued after various operations. Even where extensive and severe, it cannot always be treated with advantage.

[1] Bulletin de la Société de Chirurgie de Paris, 1859.

[2] See also Cocteau, "Sur les Varices artérielles des membres," Arch. gén. de Méd., 1865, p. 666.

[3] Arch. gén. de Méd., 1867.

[1] Pelletan, Clinique chirurgicale, vol. ii., p. 59. Paris, 1810.

[2] Dupuytren, Leçons orales, vol. v., p. 43. Paris, 1839.

The simplest method of treatment is by compression; but this is also the most ineffectual. I am not acquainted with any case in which it has proved successful, although trials have been recorded by Dupuytren, Robert,[1] and Brodie.[2] If palliation be desired, little more can be done than to provide a metal covering to protect the affected part, where the locality admits of such a provision. The ligature of the branches directly leading to the affected part has been often tried; but this also has rarely succeeded. In a case in which Breschet tied the temporal artery in a girl eighteen years of age, for a severe form of the disease, death from pyæmia took place on the fourteenth day,[3] the ligature having been carried through and round the vessel. Maclachlan tied the temporal artery, also without success, and followed it by ligature of the common carotid.[4] In a patient of Dupuytren's, both the temporal and occipital arteries had been tied unsuccessfully.[5] Gibson in a similar case tied the main branches of the temporal and occipital artery ineffectually.[6] The records of the results of this proceeding are not in its favor.

The ligature of the external carotid has been performed for a cirsoid aneurism of the scalp by Maisonneuve.[7]

He tied the right external carotid for a cirsoid aneurism of the right temporal artery occurring in a woman thirty years of age two months after a blow. The patient was suffering acute pain, and the disease beginning rapidly to extend, besides tying the external carotid, he put a ligature also round the superior thyroid artery. Pulsation ceased, the tumor diminished, and all went well for the first three weeks. Secondary hemorrhage followed the separation of the ligature, and Maisonneuve tied successively the common and the internal carotid arteries. The latter operation was followed by hemiplegia, and, after three days, by death. The brain substance of the right hemisphere was found to be deliquescent. This case had, therefore, a very unfortunate termination; but it is worthy of especial note, because it is, perhaps, the only recorded instance in which the external carotid artery has been tied for cirsoid aneurism of the scalp, and because that proceeding would appear on anatomical grounds to be the best calculated to arrest the circulation in the part affected.

Prof. Bruns,[1] who has given great attention to this subject, points out that the ligature of the external carotids is the proceeding best calculated to cut off the supply of blood to aneurisms of the scalp. He urges that the external carotids of both sides should be ligatured in such cases, and certainly where it is necessary, from repeated local hemorrhages or threatened rupture, to employ serious surgical interference, the ligature of one, and still more of the two external carotids, would best effect the diminution in the supply of blood to the arteries in the scalp; for then only the supra-orbital and frontal branches of the internal carotid would remain capable of supplying blood in this direction; and unless the disease were seated in the forehead, their influence need hardly be feared. Posteriorly, the blood would reach the scalp only through the anastomosis of the occipital arteries with the ascending cervical branches of the subclavian and the muscular twigs of the vertebral artery; whilst in front some further assistance would be given by the connection of the inferior thyroid branch of the subclavian with the superior thyroid branch of the carotid. This suggestion might not be unworthy of the consideration of surgeons in future cases.

Judging from anatomical data, the ligature of the common carotid artery, while it is pregnant with greater dangers, offers fewer advantages than the application of the same procedure to the external carotids. It has, however, been practised in at least fifteen cases, but its successes have been few. The only superiority which it possesses over the ligature of the external carotid is by shutting off the supply through the branches of the ophthalmic artery, but the large and numerous anastomoses of the carotid of the opposite side continue to supply blood, and even where a temporary improvement has followed the operation, speedy relapse has occurred, probably from this cause. Again, the disturbance of the cerebral circulation by ligature of the common carotid has of course its own peculiar dangers. So that out of eighteen cases in which the operation was performed, death occurred under the knife in three instances, and four others terminated fatally; in five an early relapse followed the first improvement; in the tenth case no final report has been given; and in only two is it stated that there was last-

[1] Gaz. des Hôpitaux, 1851, p. 130.
[2] Lancet, 1828–9, vol. ii., p. 559.
[3] Breschet, Mémoires chirurgicaux sur les différentes espèces d'Anévrismes, p. 54. Paris, 1834.
[4] Lancet, 1827–8, vol. i., p. 773.
[5] Leçons orales, loc. cit.
[6] Institutes and Practice of Surgery, vol. i. Philadelphia, 1835.
[7] Bulletin de la Société de Médecine de Paris, 1851, vol. i., p. 400.

[1] Handbuch d. pract. Chir., i., p. 161. Tubingen, 1854.

ing improvement. Instances in which the common carotid has been tied for this disease are recorded by Robert,[1] Dupuytren,[2] Kühl,[3] Bushe,[4] Wardrop,[5] Maclachlan,[6] Maisonneuve,[7] Walther,[8] Mussey,[9] Warren,[10] Hersche, Kerr, Zeiss, Arend,[11] Travers, Jr.,[12] Mott, Wood,[13] and Critchett.[14] A proceeding which has proved so fatal in the hands of surgeons so eminent must be regarded with great distrust. It is certain that in very many cases the dangers of this operation must be greater than those of the disease itself; and when those perils are surmounted, its success must still remain a contingency, which in the past has only three times been nominally realized in eighteen cases. Attempts have been made to cure cirsoid aneurisms by a method conceived after the old proceeding of Antyllus for true aneurisms. It has been proposed to lay open the tumor by a stroke of the scalpel, to stuff the arterial wound with lint, arrest hemorrhage by firm compression, and trust to the inflammatory exudation thus excited for the obliteration of the arterial channel. It is obvious that this method could only be applied to those cases of circumscribed cirsoid aneurism in which the artery forms a limited tumor by its convolutions, and to cases of limited aneurism by anastomosis. Gräfe first employed this proceeding for a cirsoid aneurismal tumor of the forehead in a boy aged ten.[15] He divided it across with a long scalpel, stuffed the wound quickly with agaric and sponge, and firmly strapped and bandaged the whole. On the following day, as the pressure was slightly relaxed, the wound granulated, and when the parts healed there was no pulsation in any part of the solidified tumor. Bell,[1] Arnott, and Lawrence[2] have succeeded also in curing aneurism by anastomosis, by incising the soft parts, and promoting suppuration in the tumor, maintaining meantime compression. It would not be reasonable to expect that the obliteration of a single large artery in a state of cirsoid dilatation could commonly be satisfactorily effected in this way; not only the fear of secondary hemorrhage presents itself, but we know that arteries are little prone to adhesive inflammation, and that arterial blood is quick to find outlets and make channels for itself. In a case of truly cirsoid aneurism this proceeding will almost certainly fail.

A more efficient means of destroying circumscribed cirsoid aneurism is to be found in extirpation *en masse* by the knife or by ligature. The latter method was employed by Sir B. Brodie with only temporary success in treating a cirsoid and anastomosing arterial tumor of the head of the size of a walnut, which had the characteristic feeling as of a convolution of meandering vessels with strong pulsations. The tumor was transfixed crosswise, and strangulated by four threads in as many parts. The cure was reported at the time to be complete.[3] But Mr. Prescott Hewett mentioned in a lecture at the Royal College of Surgeons the fact that the disease recurred in this case, and that the patient died some years afterwards, death being attributed to "nervous debility."

Excision of the tumor by the knife has been several times accomplished, and has yielded cures in cases of great severity.

Mussey's[4] case is one of the most remarkable on record. The patient, a young man aged twenty, had on the top of his head a cirsoid aneurism of great size. All the arteries of one side of the head were enormously dilated, and when the head was shaved, twenty arteries of the size of a goose-quill were felt which led to the tumor. Ligature of the left common carotid failed to cure, and the ligature of the right common carotid twelve days later also effected only a temporary improvement. Extirpation was resolved upon; two semilunar incisions being made around the tumor, which was then peeled off from the pericranium. These incisions were made gradually, the arteries wounded being tied at each half inch; this occupied more than an hour, and forty ligatures were required. In spite of all precautions, there was a great quantity of blood lost, and the

[1] Gaz. des Hôpitaux, 1851, pp. 130, 128, and Bulletin de l'Acad. de Méd., vol. xvi.

[2] In this case of Dupuytren the right common carotid was tied in 1809. The tumor remained stationary till 1848, when it again became very much ulcerated, and gave rise to frightful hemorrhage. He came under the care of M. Robert at the Hôpital Beaujon in 1857, when the left carotid was also tied, with temporary success.

[3] Kühl, Opusc. Academica, editio Claras; Lipsiæ, 1842, p. 51.

[4] New York Journal, etc., 1819, vol. i.

[5] Lancet, 1827–8, vol. i., p. 24.

[6] Glasgow Medical Journal, 1827.

[7] Supra cit.

[8] Gräfe und Walther's Journal, vol. v.

[9] Amer. Journal of Med. Sciences, 1830.

[10] Practical Remarks on Tumors.

[11] Quoted by Wernher, Handb. der Chir., vol. iii., p. 806. Giessen, 1855.

[12] Lancet, vol. ii., 1857, pp. 497, 627; vol. i., 1858, pp. 75, 399 (see also below, on p. 395).

[13] New York Journal of Medicine, 1857.

[14] Statistical Reports, Med. Times and Gaz., vols. xxx. and xxxi.

[15] Gräfe und Walther's Journal, vol. xviii., p. 20.

[1] Bell, Principles of Surgery.

[2] Lawrence, Med.-Chir. Trans., vol. ix.

[3] Med.-Chir. Trans., 1829, vol. xv.

[4] Loc. cit.

patient fell into syncope; the wound, however, granulated, and the patient is stated to have recovered completely.

Gräfe,[1] Gibson,[2] Weitzer,[3] Busch, Warren, and Guéniot[4] have also employed this method. Mr. Hart employed it successfully; freezing the tumor and cutting wide of it, so that very little blood was lost. The difficulties of this method, however, have proved very great, and its danger is considerable. The hemorrhage in some of these cases was excessive. But the issue of all recorded cases in which it has been undertaken has been successful, and excision by the knife has as yet proved the most rapid, safe, and successful means of treatment. It is obvious that great skill and caution are required to carry it into effect, and in very extensive developments of the disease it will be inapplicable. It might commonly be prudent to preface the extirpation of the tumor by the ligature of the main trunks which feed it; when practising the incisions around the tumor, the knife should travel slowly, and the arteries are to be tied as they are divided. It was by the combination of well-timed caution and necessary boldness that some of these formidable operations have been brought to a successful issue.

Cirsoid aneurisms have also been treated by galvano-puncture, galvano-caustic, and coagulating injections.

In a case under Nélaton's care, treated by galvano-puncture, the patient was a woman aged twenty, having a tumor on the forehead, made up of convoluted vessels, the coils of which could be clearly distinguished by the touch; it had arisen two or three months before, after a blow. Two needles, connected with a Bunsen's pile of thirty couples, were passed into the tumor where the pulsations were the most violent, and the current was transmitted through them for ten minutes. Next day, consolidation was found to have taken place where the positive needle had entered, and after some further sittings the whole tumor had become a hard mass, which was gradually absorbed.[5]

The case of aneurism by anastomosis of the ear and scalp, in which (as mentioned above) the common carotid was tied with a fatal result by Mr. Travers, Jr., had been previously under the care of Mr. Cutler and Mr. Prescott Hewett at St. George's Hospital. It was then treated by a combination of the electric cautery, styptics, and ligature of portions of the tumor. The result was very satisfactory; all bleeding ceased, the tumor in great part sloughed away, the ulceration healed, and the greater part of the hypertrophied vessels resumed their natural appearance. The patient remained free from dangerous symptoms during an interval of three years, when the tumor gradually returned and bleeding recommenced. Mr. Travers was sent for to see him in the country, and tied the common carotid artery; but the patient died of hemorrhage, which commenced while the ligature was still on the vessel, a striking proof of the inefficacy of that method of treatment. Had the case been kept under observation, and the original measures repeated from time to time, as fresh growth occurred, there is every reason to believe that this man's life would have been saved.

[In his Lectures on Electrolysis (British Med. Journal, 1876, i., p. 715) Dr. John Duncan refers to four cases of cirsoid aneurism treated by electrolysis, three of them successfully. In one of these he cured, by six applications of the current, a cirsoid aneurism of the scalp four inches long by three broad, upon which Mr. Syme had declined to operate. Aneurism by anastomosis, he says, is less easily treated by electrolysis. He had met with two examples, in both of which he had "been to a certain extent baffled in my efforts at cure." Both cases are narrated.]

The application of coagulating injections (perchloride of iron) was made by M. Broca to a circumscribed aneurism of the scalp, consisting of the convolutions of a cirsoid artery. Many precautions were taken to prevent the extravasation of the fluid, and the case is reported as perfectly successful.[1] Another successful case is reported by M. Demarquay, in a large aneurism by anastomosis of the palm of the hand and middle finger, occurring in a child after the blow of a stone. Here the radial and ulnar arteries, however, were first tied.[2]

M. Gosselin (see p. 392) advocates the use of coagulating injections in all those cases of the disease to which he wishes to limit the designation of "arterial cirsoid tumors," *i. e.*, those of limited extent, and formed apparently by the dilatation of minute arteries—not capillaries. He gives three cases—one in the leg, one on the forehead, and the other at the root of the nose—in which this treatment was successfully adopted.

Before quitting the subject of cirsoid aneurism, it may be well to notice that the disease is said to have occasionally undergone spontaneous cure. A patient was exhibited by Dr. Krackowizer to the New York Pathological Society in whom this had occurred, at any rate to a great extent, pulsation having disappeared, and the tumor having become solid and shrivelled in some of its parts, and the

[1] Gräfe und Walther's Journal, vol. xiv., p. 639.
[2] Op. cit.
[3] Deutsche Klinik, 1850.
[4] Gaz. des Hôp., 1868, p. 153. This author remarks that the fact of the incision being carried a little within the tumor, so as to leave a few pieces of the morbid tissue, is rather advantageous; the tissue is supple and the arteries are easily tied in it; it speedily melts away as the wound suppurates.
[5] Bull. de Thér., tome xlii., p. 354.

[1] Bull. de la Soc. de Chir. de Paris, 1866.
[2] Gaz. des Hôp., 1868, pp. 117, 126.

continuous rushing noise formerly perceptible to the patient being now inaudible while he was quiet. The patient was forty-five years of age, and the disease had lasted all his life, and had grown to a considerable size, but without pain or hemorrhage. In the same communication, Dr. Krackowizer referred to two other cases as being recorded by Orfila and Chevalier.[1]

[Lefort, in the article above referred to, has tabulated eighty-three operations upon cirsoid aneurisms, and studied the affection minutely. He calls special attention to one fact which, in his opinion, dominates the mode of treatment. That fact is, that the area of dilatation is composed of two parts, one occupied by a central tumor, the other by the afferent vessels. By the central tumor, he means the point where the tortuous and dilated vessels are most numerous and most closely packed, and where there may exist a sort of central lake, as in the cavernous angeioma, or a real aneurism, or even an arteriovenous aneurism. Whenever treatment has been directed only to the afferent vessels, its results have been incomplete or negative; their obliteration has not effected a cure. On the other hand, the obliteration or destruction of the central tumor has been followed by the return of the afferent vessels to their normal condition, and the cure of the patient. The treatment, therefore, must always be directed to the central mass, and offers two methods: the removal or destruction of the mass by the knife or caustic, and the injection of coagulating liquids. Destruction by chloride of zinc has been rarely used; it seems to protect against hemorrhage, but has the objections of long duration of the treatment, much pain, and superficial necrosis of the skull. Possibly galvano-caustic may be less objectionable and equally safe. The knife exposes to severe hemorrhage, and Lefort recommends its use only when the central tumor predominates; under other conditions he recommends injection of a solution of perchloride of iron, which has given nine successes in ten trials. He thinks the solution should be much weaker (five per cent.) than that usually employed.]

Dissecting Aneurism.

The affection which bears the name of Dissecting Aneurism is so seldom recognized during life, and when it is the subject of treatment falls so much more commonly under the care of the physician, that a very few words must suffice for its description here. The anatomical lesion consists in a rupture of the internal coats of the artery, by which the blood is allowed to pass in an unnatural channel between the coats of the vessel, parallel to its course, until finally it passes again through the coats, so as to enter the cavity of the artery again, if its course has been forwards, or falls back into the pericardium if it has made its way backwards. Dr. Peacock[1] has shown that a layer of the middle coat usually is left external to the blood, which is therefore extravasated into the thickness of this coat, and has also shown that the existence of this more resisting membrane confining the blood renders rupture into the pericardium or the cellular tissue probable. When the coverings of the blood are strong, and the fluid finds a ready passage back into the artery, life may be prolonged for a considerable period. In fact, the symptoms referred to the disease have been observed to last for years. It is not impossible that in some such cases a dissecting aneurism may pass into a common "false aneurism."[2]

The position of the original rent seems always to be in the aorta, and generally in the arch, quite close to its origin, though it has been known to be situated in the abdominal aorta, even as low as its bifurcation. The position of the secondary rupture of the inner coats, by which the blood passes back into the cavity of the vessel, varies much. A case is mentioned in which the separation extended into the popliteal artery; and in another case, in which the primary rent was in the transverse arch, the secondary opening was in the subclavian.

Death occurs soon in all cases where the blood passes out of the artery, either into the pericardium or into the surrounding tissues; and in most of those in which the blood makes its way back into the artery. But in the few instances of the latter class in which life has been protracted for years, the unnatural channel running along by the side of the natural artery is lined by a smooth membrane resembling epithelium, and thus simulates a double vessel.

The symptoms of dissecting aneurism are best illustrated by a very interesting case reported by Dr. Swayne and Mr. Keyworth of York,[3] in which the diagnosis was accurately made during life, and confirmed by dissection.

In that case, a man aged fifty-one, who had suffered for some time under symptoms referred to diseased heart, with aortic regurgi-

[1] New Syd. Society's Biennial Retrospect, 1865–6, p. 303.

[1] Contributions to the Pathology of the Heart and Arteries, "On Dissecting Aneurism." Edinb., 1849.

[2] Thus, in a case cited by Dr. Peacock (op. cit., p. 7), where the patient survived some years; "the sac commenced at the origin of the aorta, and terminated in a cul-de-sac at the common iliac arteries." So that nothing except its shape and extent would distinguish it from false aneurism.

[3] Path. Soc. Trans., vol. vii., p. 106.

tation (to which diagnosis one of his medical attendants, Dr. Latham, had added disease of the aorta), was seized suddenly one evening, as he was returning from a day of some exertion and excitement, with a very severe tearing pain in the chest, instantly followed by a second agonizing pain, which seemed to dart from mid-sternum down the left of the spinal column, and only to be arrested a few fingers'-breadth below and to the left of the umbilicus, at which point of arrest the patient thought he heard a distinct crack. He lost power in both lower extremities almost immediately, and the pulse became imperceptible in all the arteries of the lower limbs. A bellows murmur was heard below and to the left of the umbilicus. The "tearing" pain recurred, and he then passed into a state of syncope, followed by great exhaustion and distress. Reaction set in next day, with much congestion, greatly relieved by bleeding. He survived about three months, dying of dropsy and hydrothorax. The pulse had recurred feebly in the right femoral artery before death. The diagnosis of dissecting aneurism, originating near the root of the aorta and passing down so far as to compress the true channel of the vessel near its bifurcation, was made at the time of the seizure and confirmed by dissection. A transverse rent was found in the arch of the aorta, just below its three large branches; a clot of blood was impacted near the bifurcation of the artery, obstructing the left common iliac completely and the right partially. The old canal of the aorta seems to have been disused, and the arteries to have communicated with the new channel.[1]

This case will serve to illustrate the usual run of the cases of dissecting aneurisms, though it is rare for the symptoms to be so well marked or so well observed; and therefore the disease is seldom recognized or even guessed at during life. The patient is usually advanced in life, very probably a female, and suffering from hypertrophy or other disease of the heart. The first symptom is a lancinating pain in the chest, corresponding to the seat of rupture, followed by syncope; perhaps by pain at the part where the blood re-enters the artery, or where the tumor ceases. And this may be accompanied by the cessation of pulse from impaction of clot in the old channel of the artery, aided by the pressure of the blood in the unnatural channel. This stoppage of the pulse of course causes more or less complete loss of power. In other cases, where the rupture occurs near the heart and the blood falls back into the pericardium, death is sudden. I can add nothing as to the diagnosis of the disease which may not be gathered from the symptoms in the above case. The only case in which I can conceive such an affection becoming the subject of surgical diagnosis, is where loss of power, loss of pulse, and threatening gangrene follow on dissecting aneurism; and the diagnosis lies between this disease and embolism from the more ordinary causes of impacted clot.

[1] In this case, Dr. Swayne, after having his attention specially drawn to the fact by Dr. Peacock, distinctly asserts that the extravasation was *between* the external and middle coats.

GENERAL OBSERVATIONS ON LIGATURE OF ARTERIES.

It is in operations for the ligature of arteries that the proceedings of the operating theatre most nearly resemble those of the dissecting room; and it is in these operations, more than in any others, that minute anatomical knowledge is advantageous. Before undertaking to tie an artery, the surgeon ought to know its general course and its relations, and especially the prominent part or parts which are to guide him to the position of the vessel (to serve as rallying points, as the French operators say); he ought to have familiarized himself by frequent dissection[1] with the thickness of the parts covering it, and their appearance, as far as that can be judged of on the dead body; and, finally, he ought to know the usual position of its principal branches, and the anastomoses by which the circulation may be expected to be restored. It is advisable also to be aware of the leading peculiarities in course, relations, bifurcation, etc., which the operator may perhaps meet with, and for which he ought to be prepared.

Having all these anatomical details clearly present to his mind, and being familiar with the various methods by which the vessel can be reached, the surgeon will be prepared to adopt that method which seems to him best suited to the case which he happens to have before him. It is better, if possible, to avoid the part of an artery where large branches are known to come off, since in such cases the clot that should form in the vessel during the process of its severance will be absent between the ligature and the opening of that branch; and although it is true, as has been shown above,[2] that the clot is not

[1] So experienced an operator as Sir P. Crampton relates, that before tying the common iliac artery he practised the operation seven times on the dead subject, and says that each time he did so he learned something towards the satisfactory performance of the operation.

[2] See Guthrie's Comment., ed. 1855, p. 80; Porter, On Aneurism, p. 187; Aston Key, in Guy's Hospital Reports, vol. i., pp. 65, 66.

necessary as a preservative against secondary hemorrhage, inasmuch as the wound in the artery unites by lymph, which seals it, and acts as a barrier to the blood; yet that barrier is certainly strengthened by the clot in the artery, as is shown by the fact that secondary hemorrhage is less common in situations where a long internal coagulum is formed.

In dissecting down upon an artery, it is important to have a clear view of each successive structure as it is exposed; and therefore bleeding from any small veins or arteries that may be divided in the superficial incision should be at once restrained by ligature or pressure. No attempt should be made to hurry over the proceedings; but as each layer of tissue is divided the one below should be carefully examined with the eye and finger. Most large arteries run in a sheath of fascia, which also contains their accompanying vein. When the level of this sheath is reached, great care must be taken in applying the knife. The cellular membrane or muscles over the sheath having been properly divided or drawn aside, that structure itself should be cleaned by scratching with the finger, assisted by the blunt point of the director or silver knife. When the sheath has been fairly exposed, and the beating of the artery can be plainly felt through it, a small part of the membrane should be raised by the forceps and divided with the knife held horizontally, as is done in opening the sac of a strangulated hernia. The small hole over the artery must be extended with the point of the director or aneurism needle,[1] till a little channel has been made round the vessel, through which the thread can be carried easily. Great care is necessary to use the instruments with all gentleness at this stage of the proceedings, on account of the proximity of the vein. The needle is to be passed under the artery, in a direction away from the vein; *i. e.*, the point of the needle is first passed between the artery and vein, and brought out on the side of the artery away from the vein.[2] When the needle has been passed under the artery, the latter should be compressed between the point of the finger and the curve of the needle, in order to see that the beating in the tumor is completely stopped, or the bleeding completely commanded; and to judge also by the feeling that no other structure has been taken up with the vessel. This is the more necessary in cases where the artery, as in the case of the subclavian, lies very deeply, perhaps out of sight, and touching a large nerve or other important structure.

Some difference of opinion exists about the administration of chloroform in operations on arteries. M. Robert[1] advocates the performance of these operations without anæsthetics, but the contrary practice is now universal, and I think rightly so, in this country. [Among surgeons in the United States, the use of ether in these operations has been very general; and there seems to be no reason why the question should not be settled on the same grounds as in any other case.] Opinions differ also as to the direction in which the incisions may be most advantageously made. Most operators make these incisions in the course which the vessels are known to pursue; others prefer an incision which crosses obliquely the course of the vessel. The former plan enables the operator more clearly to anticipate and recognize the structures successively exposed; the latter renders him more certain not to miss the vessel altogether, and also enables him more conveniently to investigate the parts around, should any anomaly, such as a high bifurcation of the brachial or femoral artery, render it necessary to search about, without any definite anatomical guide, for a vessel not usually present.

Large arteries ought not to be tied unless a reasonable probability exists of the recovery of the patient from an operation which must always be grave, and which is far more fatal than most surgeons appear inclined to admit;[2] but if the disease or injury admits of no other cure, nothing need be held to be a formal contra-indication to the operation; not disease of the viscera, not disease of the heart, not even disease of the artery itself, although it must be allowed that the latter complication renders the case almost hopeless.[3]

[1] Mr. Syme, however, whose experience in tying arteries is perhaps more extensive and more favorable than that of any other living operator, prefers cleaning the artery with the edge of the knife, using it till the whitish coat of the artery is clearly seen. If this plan is adopted, great care must be taken in scratching the vessel; and perhaps it will be well to blunt the edge of the knife a little.

[2] Further directions as to tying the arteries for a wound will be found in vol. i., p. 471 et seq.

[1] Conf. de Clinique chir., Paris, 1860, p. 48.

[2] See notes on pages 347 and 353.]

[3] If the artery on which the operation is performed be found, when exposed, to be extensively diseased, four courses are open. In aneurisms of the extremities, the safest course would be to amputate; in a few cases the surgeon might resort to acupressure; usually, the operation would be completed; while sometimes the case would be abandoned to nature. Under the head of ligature of the innominate, a remarkable instance of the good result of the latter course will be mentioned. The surgeon must rely upon his own judgment.

But, on the other hand, the most mature consideration is requisite to assure the surgeon that the case is really beyond the reach of other and milder measures. So much has lately been done to diminish the percentage of cases of aneurism which require ligature, that it may now be said that the presumption in a case of surgical aneurism is rather that it is curable without operation than that an artery will require ligature. It will be my object in the following remarks upon each particular form of surgical aneurism, to point out in what cases milder measures may be expected to succeed; and when these fail, by what operations the affected arteries or the trunk above them can be reached; and in treating of each form, I shall observe the same order as is followed in the essay on AMPUTATION, taking the upper limb first, with the head and neck, and proceeding from the extremity towards the trunk.[1]

ANEURISMS IN THE FOREARM AND HAND.

Aneurisms diminish in frequency as the vessels diminish in size; hence the disease is very rare in the forearm and hand; indeed, is hardly ever seen except as the result of accident. I was enabled, however, through the kindness of Mr. De Morgan, to see a case of aneurism of the upper part of the ulnar artery among his patients at the Middlesex Hospital. In this instance, as I suppose would usually be the case, the whole of the arterial system was diseased, and a loud murmur accompanied the action of the heart.[2]

There is generally little difficulty in diagnosing an aneurism in the hand or forearm, nor in determining whether it be simply arterial or arterio-venous. The treatment of spontaneous aneurism of these arteries would be exceedingly simple if the disease could be found in a subject otherwise healthy. Digital pressure on the artery leading to the aneurism, maintained by the patient himself as long as he was able for several days, much reduced the size and pulsation of the tumor in the case above mentioned. If this or other forms of pressure failed, recourse would be had to the Hunterian operation, and even in the last resort the old operation would present no great difficulty. I have performed it with great ease and success in a small traumatic aneurism of the superficial palmar arch. A case is referred to on p. 340 (note), where a small aneurism in the palm was successfully extirpated by chloride of zinc.

The arteries of the forearm far more often require ligature on account of a wound. It is hardly necessary to give minute directions for the performance of such operations as tying the ulnar or radial near the wrist. Common sense would suggest to keep the tendons intact; and this being done, and care taken to avoid mistaking a nerve or piece of fascia for the artery, all the cautions necessary for the operations are exhausted. It is a matter of indifference whether the venæ comites are included in the ligature or not.

If the skin is unbroken, as when the radial or ulnar, or both, are tied for a wound in the palm of the hand, it is merely necessary to make an incision, from an inch to two inches in length, between the tendons which accompany the vessel, divide the deep fascia, which is often strengthened by a distinct thin layer over the ulnar artery; and if the tendon of the flexor carpi ulnaris overlaps the vessel (as is usually the case), draw it inwards, and then the vessel will be exposed by a little dissection, enclosed in its sheath—the radial accompanied merely by a small filament of nerve lying above the fascia, which probably will not be seen, the ulnar having its nerve on its inner side.

The radial can be exposed, if necessary, higher up, by a similar operation; but now the muscular belly of the supinator longus requires to be drawn outwards, and the position at which the radial nerve lies against the artery (on its outer side in the middle third of the forearm) must be remembered. The different directions of the fibres of the supinator longus and pronator teres must be borne in mind. Their vertical direction will always distinguish those of the former muscle.

Ligature of the ulnar artery near its origin is a much more difficult operation. It is only required, as far as I know, in cases of wound. The very commencement of the artery may be exposed after the division of the bicipital aponeurosis, without cutting through any muscular fibres; but the depth of the parts is very

[1] In speaking of the ligature of arteries, it has been found impossible to separate the cases in which such operations are required for aneurism and for injury; but as the former class of cases is by far the larger, it was judged best to include the description of all the operations in the present essay.

[2] Typical examples of traumatic aneurisms in the forearm will be found in Ormerod's Clinical Collections, pp. 150–1. A case of spontaneous aneurism of the radial artery was under Mr. De Morgan's care at the Middlesex Hospital, and recovered spontaneously, and an aneurism of the ulnar, the result of embolism, under Mr. Pollock's care, is figured at p. 321. See also Erichsen, op. cit., vol. ii., p. 98; and the figure on p. 316 of this essay.

considerable, and where there is much effusion of blood, it is by no means easy to recognize the wounded vessel, which may be the humeral itself, or either of its branches. In the only case where I ever saw this operation attempted, it was given up and the arm amputated. On examination it turned out that all three arteries were injured, the bifurcation of the main trunk having been cut across. To tie the artery a little lower down, Mr. Guthrie[1] recommends that an incision should be made through the aponeurosis of the biceps, the pronator teres exposed and drawn towards the ulna, and the dissection continued till the median nerve is brought into view, crossing the artery from without inwards. Then, if it is necessary in order to reach the vessel, part or the whole of the pronator teres is to be divided. In other cases it may be more convenient to divide the muscles from below, an incision being made from the point at which the muscular and tendinous portions of the flexor carpi ulnaris are felt to join, upwards for four inches, and the sheath exposed as the vessels emerge from beneath the flexor sublimis digitorum. If the wound be higher up, the division of the latter muscle, and even of those adjoining it, if it be necessary, may be pursued from this point. More or less loss of power will probably follow the division of the muscles, especially if extensive; but this is likely to be transient, and if not, it is a less evil than the loss of the hand. The nerve will probably be the first of the structures around the artery which comes into view.

At *the bend of the elbow* aneurismal swellings are almost always traumatic, and generally of the arterio-venous class. If the disease be a simple arterial aneurism, whether traumatic or spontaneous, pressure upon the brachial artery is the first resource of the surgeon. Acute flexion of the limb will very probably succeed, either by itself or as an accessory to the indirect compression. If these means should fail, the natural course, irrespective of any special complication, will be to tie the brachial artery. The treatment of arterio-venous aneurism has been discussed above (pp. 389–391); we need not, therefore, detain the reader on the diagnosis or treatment of aneurism at the bend of the elbow; nor does that of aneurism in the arm call for any further remark. We have, then, only to describe the operation on the brachial artery, which may be required for these affections.

Ligature of the brachial artery for aneurism, or for wound of the lower part of the limb in which the wounded artery cannot be secured, is thus performed. An incision is made, about three inches in length, along the inner margin of the biceps muscle in the middle of the arm; or if that muscle be obscured by œdema, fat, or imperfect muscularity, then in a line drawn from midway between the two flaps of the axilla to the middle of the bend of the elbow. In making this incision, perhaps the basilic vein will be seen, and should be avoided. The fascia having been divided upon a director, the operator comes down immediately to the packet of vessels and nerves. The internal cutaneous and ulnar nerve lie to the inner side of the artery, and may or may not come into view; or perhaps the external cutaneous will be seen on the other side of the vessels. The difficulty of the operation (which is sometimes considerable) consists in recognizing and isolating the artery. What renders this more troublesome is, that the artery, besides being closely surrounded with other structures, does not always maintain the same relation to them. The median nerve is more commonly above the artery, and is the first cord seen below the fascia; but occasionally it will be found under the artery. Again, the brachial artery may not be the only vessel which requires ligature, since another considerable vessel may exist in the neighborhood (probably a radial artery given off high up, or a vas aberrans), which will have to be sought;[1] it is, however, usually found close to the one first exposed. The veins often encircle the artery with an intricate plexus of anastomosing branches; hence the operation is frequently far less easy than the superficial position of the vessel would seem at first sight to promise. It is true that a little patience and anatomical knowledge will dispose of these difficulties; but they should not be forgotten in deciding the question of treating an arterio-venous aneurism at the bend of the elbow, since, besides the other objections to the Hunterian ligature, it may be said that, as an operation, it will very likely be found no easier, and perhaps much more difficult, than the old operation.

Ligature of the brachial artery is usually very successful, as far as the operation itself goes. It is true that in Porta's statistical table of six hundred cases of ligature of all arteries, ten out of sixty-eight cases of ligature of the brachial artery are said to have died; but in the absence of details we cannot tell whether they died from the effects of the operation. Gangrene is, however, believed to be sometimes a consequence of the application of a ligature

[1] Commentaries, p. 294.

[1] See the figure on p. 386.

to the upper part of the brachial artery, the anastomosis between its branches and those of the axillary being rather scanty (vol. i., p. 466).

Axillary Aneurism.

Axillary aneurism, like popliteal, depends in a large proportion of cases upon injury, more or less severe, to the artery, in the violent movements of the joint near which it lies.[1] This injury may, as it seems, vary from complete rupture of the vessel to some slight contusion or strain, only appreciable by its results. In the former case the aneurism is of the consecutive, in the latter of the false, variety. So far there is little essential difference between axillary and popliteal aneurism. But the different anatomy of the parts occasions a great difference in the curability of these affections. The cellular space of the axilla is so loose and so large, that the tumor may attain a very unmanageable development before any treatment is called in. So that the great advantage which is always obtained in an aneurism by the condensation of the parts around the sac, and the commencement of spontaneous cure in the deposition of laminated fibrin, is less likely to occur in axillary than in other aneurisms; while the growth of the tumor, even if opposed by coagulum in one part, can easily go on in another. Further, in the treatment of axillary aneurism the Hunterian operation is less likely to be successful, since, instead of an artery pursuing a long and comparatively superficial course, without any considerable branches, as the superficial femoral does, the vessel upon which the axillary aneurism is formed is short, deep, and so crowded with large branches, that a ligature can only be applied in close proximity to one or other of them.

It is often said that axillary aneurisms are more difficult to treat than others, because they are so often traumatic. But this seems to me a confusion of terms. A *traumatic aneurism* is more easy to treat than a spontaneous aneurism. What is meant is, that there is so often no aneurism at all, but only a lacerated artery; and a lacerated artery is not much more amenable to indirect methods of treatment than a wounded one. The presence or absence of a sac determines this point, and this fact is shown by the presence or absence of *pulsation*. I venture to think, with all possible deference to the great authority of Mr. Syme, that in his paper on the subject of axillary aneurism,[1] which gave a new impetus to the discussion of the very interesting question of the treatment of that affection, this point has hardly been made sufficiently plain to the reader, although it may have been present to the mind of the author. Mr. Syme begins his essay with the rather startling avowal that the doctrine, which he had been teaching for more than thirty years, of the superiority of the Hunterian operation to the old mode of treating aneurism, is questionable. But the instance upon which he supports this assertion is one in which, accurately speaking, there was no aneurism at all. The history of an accident, the presence of a large and increasing collection of blood, an arterial bruit, and no pulsation, afford as clear evidence of laceration of the artery, unaccompanied by the formation of an aneurismal sac, as can be obtained; and in such cases, whether they be in the axillary space or the popliteal, the Hunterian operation may be expected frequently to fail; and the only sure resource is to tie both ends of the bleeding vessel.[2] Still the situation of the injury will very much modify the treatment which would be recommended. In the popliteal space the old operation is very difficult and very fatal, while the Hunterian operation is easy. On this account, when the popliteal artery is ruptured, the ligature of the femoral artery has been practised, though unsuccessfully.[3] Amputation is here usually the proper course. But in the axilla, the old operation has been found, in skilful hands, not more difficult than the ligature of the subclavian; it is possible that it may prove less fatal; and it is certain, if not fatal, to cure the disease, which ligature of the subclavian may fail

[1] On the subject of subcutaneous laceration of the axillary artery, I would especially refer the reader to Mr. Callender's paper, "Respecting Rupture of the Axillary Artery in Reducing Dislocations at the Shoulder-joint," in vol. ii. of the St. Bartholomew's Hospital Reports.

[1] Med.-Chir. Trans., vol. xliii.

[2] "We must especially be upon our guard," says Mr. Erichsen, "not to be misled by the term *aneurism*, and not to attempt to treat the condition, resulting from wound or subcutaneous laceration, by the means that we employ with success in the management of aneurism proper. In the diffused traumatic aneurism" (which is Mr. Erichsen's term for a ruptured artery) "there is no sac, properly speaking; and hence those changes to which a sac is necessary cannot take place. I doubt whether there is a case on record in which the Hunterian operation for aneurism, applied to the condition now under consideration, has not terminated in danger or death to the patient, and in disappointment to the surgeon."—Science and Art of Surgery, 7th ed., i., p. 324.

[3] See below, Ligature of the Popliteal Artery.

to do. Hence, in a case of effusion of blood in the axilla from accident, where no indications of a sac exist, most surgeons would agree with Mr. Syme that the ligature of both ends of the injured vessel is a far more rational and more promising proceeding than the ligature of the subclavian, if either operation be requisite. But both are formidable operations, difficult to carry out satisfactorily, and even when performed in the most dexterous manner very dangerous to life. In spontaneous aneurism, or in traumatic aneurism properly so called, *i. e.*, in tumors the outlines of which are well defined, the pulsation plainly perceptible, and which can be emptied by pressure if the circulation be commanded, what course should be pursued? Mr. Syme appears to be in favor here also of emptying the sac and tying the artery above and below it, and has performed the operation once successfully. Other surgeons would prefer to tie the subclavian, in spite of the great mortality with which that operation has been attended.[1] Perhaps the decision will be best made according to the circumstances of the individual case. If the tumor extend far up, so that the clavicle is much raised, and the neck short and fat, the operation on the subclavian is so dangerous and so difficult that it would be better to operate on the aneurism. In contrary circumstances (*i. e.*, where the subclavian triangle is easily accessible, and the aneurism buried deep in the axilla), the subclavian may be tied with good prospect of cure. The objection to the old operation, which rests on the probably diseased condition of the artery near the tumor, has less force in this situation than in the popliteal space; since in any case the ligature must be placed near the aneurism.[2]

But would not all these affections, viz., ruptured artery, traumatic aneurism, and spontaneous aneurism, be found amenable to milder treatment if it were more perseveringly tried? It will strike the reader of most of the cases of axillary aneurism, in which the details are fully given, how well adapted they seem to have been for the treatment by digital pressure, had that method been known.[1] At any rate, if moderate pressure on the artery where it crosses the first rib can be made (as it often can), by means of the finger or a pad, so as to control the circulation, the surgeon is not doing his duty to his patient if he expose him to the risk of a great operation without a careful and patient trial of this safe and often most successful method.[2] If direct pressure by a pad in the axilla, or by bandaging the arm across the chest, appears to assist in controlling the pulsation and bruit, it may be at the same time employed. Instrumental compression is less easy on account of the shape of the parts, and is less likely to be well borne from proximity of the large nerves to the subclavian artery; but it might possibly be advisable to try it in the absence of a sufficient staff of assistants to make pressure with the fingers. If these means fail, one or the other of the operations above discussed must be performed.

Mr. Syme thus describes the operation which he performed on the case of ruptured axillary artery on which he first practised the *old operation:* "Chloroform having been administered, I made an incision along the outer edge of the sterno-mastoid muscle, through the platysma myoides and fascia of the neck, so as to allow a finger to be pushed down to the situation where the subclavian artery issues from under the scalenus anticus, and lies upon the first rib. I then opened the tumor, when a tremendous gush of blood showed that the artery was not effectually compressed; but while I plugged the aperture with my hand, Mr. Lister, who assisted me, by a slight movement of his finger, which had been thrust deeply under the upper edge of the tumor and through the clots contained

[1] Especially in the practice of London surgeons during the last few years. See below, on Ligature of the Subclavian Artery.

[2] On this head I would refer the reader to a very interesting case of axillary aneurism, too long to quote, by Dr. Morton, in the Am. Journ. Med. Sci., July, 1867, p. 70, in which the left subclavian artery was tied in its second part, between the scaleni; the tumor suppurated, hemorrhage occurred on the forty-third day, and the limb became gangrenous; a vessel believed to be the subscapular was tied; the limb was removed at the line of demarcation; hemorrhage recurred; and the stump was removed from the shoulder-joint successfully.

[1] See a case described by Pelletan, Clin. chir., vol. ii., p. 50. "By raising the shoulder slightly, the subclavian artery could be felt isolated; and by making even slight pressure with the finger, its pulsation and that of the entire tumor could be arrested." So also in Mr. Crossing's case, in Med.-Chir. Trans., vol. xvi., p. 344, pressure on the artery as it crossed the rib was easily made; and the same may be said of Mayo's case, ibid., p. 360; and of Mr. Poland's in vol. lii. of the same Transactions. I merely instance these cases among many others to which the same remark applies.

[2] Mr. Poland has related a case in which digital pressure was used with success in the treatment of a small aneurism of the subclavian artery (Med.-Chir. Trans., vol. lii.). Here, however, the artery rose much higher in the neck than usual, and was supported on a process of bone, possibly a cervical rib. The presence of such a rib would much facilitate the application of digital pressure to the subclavian artery.

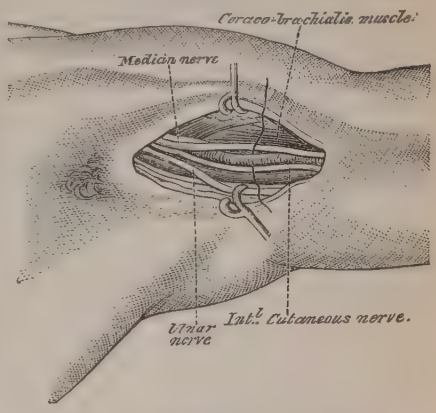
in it, at length succeeded in getting command of the vessel. I then laid the cavity freely open, and with both hands scooped out nearly seven pounds of coagulated blood, as was ascertained by measurement. The axillary artery appeared to have been torn across; and as the lower orifice still bled freely, I tied it in the first instance. I next cut through the lesser pectoral muscle, close up to the clavicle; and holding the upper end of the vessel between my finger and thumb, passed an aneurism-needle, so as to apply a ligature about half an inch above the orifice."[1]

Mr. Syme adds the important remark, that the extreme elevation of the clavicle occasioned by the great effusion in the axilla, which rendered the artery so inaccessible from above, facilitated this proceeding from below. It was no doubt the same circumstance, of the great depth at which the third part of the subclavian was situated, which rendered it necessary to make an incision over it through the deep cervical fascia before effectual pressure could be made on it; a precaution which ought to be taken in all similar cases.

Ligature of the axillary artery after the Hunterian method.—The axillary artery is sometimes, though rarely, the subject of operation for aneurism in the arm, the result usually of injury. This operation has been much decried, on the supposition that the necessary proximity of large branches to the ligature would surely lead to secondary hemorrhage. We have, however, as above noted, the high authority of Mr. Guthrie, and others, for saying that this apprehension is exaggerated. The depth at which the artery lies, and the necessity for cutting through a mass of muscle to expose it, form another, but not a very powerful, objection to the operation, which seems, notwithstanding this, to have been often effected without much difficulty. Chamberlaine[2] tied the axillary artery just below the clavicle, by a horizontal incision parallel to the lower edge of the bone, commencing about three fingers' breadth from the sternal end of the bone, and terminating about an inch from the acromion. "A second incision of about three inches in length was made obliquely through the integuments over the deltoid and pectoral muscles, meeting the first nearly in the centre. Then the clavicular origin of the pectoralis major was separated from the bone, and the artery brought into view by removing the fat and cellular membrane." The only difficulty experienced was in passing the needle, in consequence of the depth of the cavity and the struggles of the patient. It was accomplished by passing an eyed probe under the vessel, the blunt end first, as I understand the account. The patient made a good recovery. Roux[1] appears to have succeeded in tying the artery above the coracoid process, by an incision parallel to the course of the vessel, between the deltoid and pectoralis major, without dividing any muscular fibres: but his description is not very full. Most surgeons would think that the greater room and better view of the parts obtained by the division of the muscular fibres would be a great advantage, and would therefore prefer the former method.

[Ligation of the axillary artery in its upper portion is an operation of difficult execution and unfavorable results. The vessel lies at a considerable depth under thick muscles, is covered in front by the axillary vein, and gives off numerous branches, some of which traverse the tissues through which it must be approached. The causes of failure have been recurrence of hemorrhage by early establishment of a free collateral circulation,

Fig. 327.



Parts concerned in ligation of axillary artery (Bryant).

direct hemorrhage through the wound, and gangrene in consequence of injury to the vein, or, perhaps, of ligature of too many arterial branches encountered in the dissection. The results may probably be improved by the use of the antiseptic catgut ligature and by a modification of the mode of operation. It is very desirable that the cephalic vein should not be divided, and that the ligature should be placed upon the artery close to the clavicle, so as to be above the branches. The procedure which seems to be the best is one recommended by Farabeuf (Bull. de la Société de Chirurgie, 1880, p. 541): an incision is made parallel to and about half an inch below the clavicle, extending two inches on each side of the centre

[1] Med.-Chir. Trans., vol. xliii., p. 141.
[2] Med.-Chir. Trans., vol. vi., p. 128.

[1] Quarante Années, etc., vol. ii., p. 133.

of the bone; the fibres of the pectoralis major are then exposed and separated from the clavicle, the sheath of the subclavius muscle opened throughout the full extent of its exposure, its lower lip drawn down, and its deep portion scratched through under the centre of the incision. The artery lies immediately below, covered more or less completely by the vein, and may be recognized as the first cord exposed when the latter is drawn inwards. The patient should be so placed that the shoulder can be drawn well backwards and outwards. The method, which consists in seeking the upper border of the tendon of the pectoralis minor as a guide, exposes to injury more of the cephalic vein and of the branches of the acromio-thoracic artery.]

In both these [former] operations the artery is sought from above; an operation which Mr. Guthrie vehemently condemns.[1] The operation which he proposes to substitute is one by which the artery is sought from below, which would of course be the preferable operation if the lower part of the artery (that below the pectoralis minor) is to be operated on, and by which Mr. Guthrie says that any part of the artery can be exposed, and the whole vessel traced up to the first rib, if required. An incision three inches long is to be made over the course of the artery upwards from the lower edge of the pectoralis major, and perpendicular to the course of its fibres. These having been divided, a full view of the axilla and its contents is obtained. If the operation is done for a wound, the bleeding mouth of the artery will be seen by relaxing (if necessary) the pressure which, in such a case, will have been put on the subclavian. Mr. Guthrie says, that "the finger introduced into the upper part of the wound would enable the operator to divide the pectoralis minor muscle if necessary, or to draw it upwards; when the artery, vein or veins, and the plexus of nerves, might be traced up to the first rib without difficulty." Nevertheless, in any operation on this artery, the large vein which lies in front, and to the thoracic side of the vessel (sometimes, as Mr. Guthrie hints, double), the numerous large nerves which surround it, and the great number of branches which are given off from the artery, and which again give off large and numerous vessels towards the inner and front parts, where the operation must be conducted, will occasionally prove embarrassing to the most dexterous operator, though in other cases, as in those above referred to, the surgeon may have the good fortune to escape them.

Of the success of this operation, no sufficient data exist to enable us to judge; it appears, however, both from published cases and *à priori* reasoning, that little danger of gangrene exists if the artery be tied above the origin of the subscapular, since that artery anastomoses so freely with branches of a higher origin (posterior and supra-scapular), that the blood is most readily conveyed around the ligature. Secondary hemorrhage is more to be apprehended, and we may conjecture that diffuse suppuration in the loose cellular tissue of the axilla would often ensue.

I will not detain the reader with any remarks in this place upon the consequences of wounds of the trunk of the axillary artery, as distinguished from those which follow the division of one of its large branches near the trunk. The persistence of pulse at the wrist or in the brachial artery is the main feature in the diagnosis; the extent and the advance of extravasation of blood the circumstance which decides the necessity of cutting down on the wounded vessel.[1]

Ligature of the subclavian artery in the third part of its course may be thus effected: the patient is to be laid down on the sound side; the arm should be depressed as far as the tumor will allow, in order to draw the clavicle as much as possible out of the way of the artery; the skin of the neck should be pulled down into the chest by the fingers of the operator's left hand, while he makes an incision down to the bone along the prominent part of the clavicle, from the edge of the sterno-mastoid to the trapezius. The skin is now allowed to retract, when the incision will lie above and parallel to the clavicle. In this way the external jugular vein, which here dips below the clavicle, will be avoided, and may be drawn with a blunt hook inwards or outwards (the former will generally be found more convenient) during the rest of the proceedings. If the muscles approach near to each other, the sterno-mastoid ought to be partly cut away from the clavicle.

If the patient be stout, or the clavicle much pushed upwards, so that the artery lies at a great depth, it is advisable to connect the transverse incision with one running upwards from its inner end, and dissect the flap outwards.[2] The cervical fascia must now be cautiously divided on a director to the extent of the wound, commencing from the outer edge of the sterno-mastoid, when the knife may be

[1] Wounds and Injuries of Arteries, p. 54.

[1] See John Bell's Surgery, Charles Bell's ed., 1826, vol. i., p. 416.

[2] Or a flap may be formed by an angular incision projecting beyond the sterno-mastoid muscle, and this flap dissected inwards. (Skey, Operative Surgery, 1st ed., p. 220.)

laid aside, and the parts separated by means of the finger, assisted by the point of a director or other blunt instrument. The finger of the operator is now passed into the "subclavian triangle," a small space bounded by the omohyoid muscle above, the clavicle below, and the sterno-mastoid at the inner side. Lying somewhat parallel to, but deeper than, the sterno-mastoid, is the scalenus anticus muscle, which must always be carefully sought and traced down with the fore-finger into the first rib. When the point of the finger is placed upon the ridge on which the muscle is inserted into the rib (and which terminates on the inner border of the bone, in a very perceptible tubercle), the artery will be felt immediately under the finger. The other structures contained in this triangle are two branches of the thyroid axis, the transverse cervical and supra-scapular, the veins accompanying them (which empty themselves into the external jugular), the brachial plexus of nerves, with some small branches, and finally an absorbent gland. If the transverse cervical artery should be divided, it will be tied without difficulty. The supra-scapular is usually below the clavicle, and is not seen. It did, however, come into view in Dr. Warren's case,[1] and it was not without difficulty that he was enabled to avoid it; which, as Dr. Warren remarks, it is important to do, both on account of the difficulty that might be experienced in securing it, and because it is an important agent in the collateral circulation.

Fig. 328.

Fig. 329.

The above cuts are placed side by side for the purpose of comparison. In Fig. 328, *a* shows the incision for ligation of the axillary; *c* and *d*, or a combination of the two, that for ligation of the subclavian in its first part, or of the innominate; *f*, that for the external carotid or lingual. In Fig. 329, *b* is the line of incision for the subclavian (third part); *e*, thrt for the common carotid.

Should either of the veins, or even the external jugular, be much in the way, it may be tied with two ligatures and divided. The gland may be removed without scruple if necessary.[1] Much care is required to separate the artery from the lowest cord of the plexus, which lies so close to it that it often derives pulsation from the artery, and appears to be a part of it. This mistake is more liable to be committed when the artery is so deep as not to be easily brought into view. It is on this account that it is of so much consequence in these cases to keep the finger carefully on the anterior scalenus muscle, since the artery is more easily recognized by its position with respect to that tendon than by anything else.

This operation varies much in difficulty. On the dead subject, or in the living when the person is thin and the parts natural, nothing is more easy; on the contrary, when the clavicle is driven upwards, is greatly curved, as in persons accustomed to manual labor, and the patient stout and muscular, it is one of the most difficult of all the operations on arteries. In these latter circumstances, the artery lies at the bottom of a deep cavity liable to be filled with blood oozing from the many small vessels which will probably be divided in such a case, and the parts cannot be distinguished. It is not wonderful, therefore, that such operations occupy much time, and sometimes terminate in disaster. Two successive cases of Dupuytren's are on record;[2] in one of which everything went on favorably; while in the other the operation occupied an hour and forty-eight minutes, and on the death of the patient, four days afterwards, it was found that the ligature had been thrust through the

[1] See a case by Mr. Crossing, in Med.-Chir. Trans., vol. xvi., p. 340.

[1] Infra cit., p. 406.

[2] See Quain's Anatomy, ed. 1848, vol. i., p. 504.

vessel, and included one of the large nerves of the brachial plexus, along with half the artery. Another accident to which the operation is liable in complicated cases, is an injury of the pleura, or disturbance of the subserous cellular tissue which connects that membrane to the first and second parts of the subclavian artery. Thus in a case of much difficulty operated on by Dr. Warren in America,[1] the air rushing into the chest with a whistling sound gave evidence of the infliction of a wound on the pleura. The patient nevertheless recovered. Mr. Aston Key[2] considers that pleurisy and the inflammation of the subserous cellular tissue leading to abscess in the anterior mediastinum will be found to be the most common causes of death in this operation—an opinion which the statistics quoted below go far to support; and points out the necessity that there is, on this account, for not meddling if possible with any part of the vessel except that which lies immediately on the rib, by which means such an injury to the serous membrane or subserous tissue will be avoided.

That ligature of the subclavian artery should be a very fatal operation, when performed for axillary aneurism, will surprise no one who considers the conditions under which it is performed. In the first place, the procedure resembles Anel's operation almost as much as Hunter's.[3] Hence suppuration of the sac from loose formation of clot, and secondary hemorrhage from disease of the artery, may be anticipated. Again, the ligature must be placed in the immediate vicinity of large branches. Then, again, the deficient formation of laminated clot is further favored by the absence or loose structure of the aneurismal sac, and by the want of resistance in the parts which surround it (see p. 401). For these reasons the sound cure of the disease is less probable, and suppuration in the sac far more common in axillary than in other aneurisms; and if to these sources of danger, those above noticed, which result from the anatomy of the parts, be added, we shall have, I think, a satisfactory explanation of the high mortality of the operation.

In Norris's table[4] of the statistics of this operation, sixty-nine cases have been collected in which the operation was performed for various causes. The result was most disastrous: thirty-six recoveries against thirty-three deaths; a mortality little less than what is supposed to prevail after amputation at the hip-joint. The few cases recently operated on in London, and reported in the Medical Times and Gazette,[1] have turned out still more unfavorably; out of six cases two only have recovered.[2] Porta's table of the published cases gives a more favorable account, since out of seventy-four cases twenty-seven only are reported to have died; but as Norris's and Porta's tables were both published in the same year, and as the thirty-three deaths in the former table did certainly occur (for the references to all the cases are given), it is clear that Porta must have missed some of the fatal cases. On the other hand, it is quite possible that Porta may have had access to some successful cases which were unknown to Norris: but the Italian tables not being accompanied by references, as the American are, it is impossible to say how many of Porta's seventy-four cases correspond with Norris's sixty-nine. The most favorable view of the case would be that which would assume that Porta had merely missed six out of the thirty-three fatal cases, and had tabulated all the rest. Now, adding these to the list would give thirty-three fatal cases out of eighty, a mortality of 41.25 per cent. It may safely be said, then, that the average mortality of ligature of the subclavian artery for all causes, and in all cases of hospital and private practice, town and country, taken indiscriminately, is considerably above 40 per cent.

As to the causes of this mortality, we get no information from Porta; out of the thirty-three deaths in Norris's table, five were unaccounted for; of the remaining twenty-eight, nine were caused by hemorrhage, six by gangrene, five by sloughing or suppuration of the aneurism, five by intra-thoracic inflammation, one by exhaustion, one by effusion on the brain, and one by "inflammation."

These facts, as well as the theory of the matter, certainly tend to exhibit ligature of the subclavian artery as one of the least promising of all the surgical operations, and must dispose surgeons to try the method recommended to them by Mr. Syme in any case in which that procedure does not appear too dangerous.

[Mr. Holmes gave much attention to the treatment of axillary aneurisms in his lectures (Lancet, 1873, ii., pp. 443, 583), and after describing some cases cured by pressure upon the subclavian, laid down the following propositions:—

"1. That there are a great number of these

[1] Med.-Chir. Trans., vol. xxix., p. 32.

[2] Med.-Chir. Trans., vol. xiii., p. 8.

[3] It differs indeed in principle from Anel's, so far as Anel's method can be said to have any principle; for as the aneurism may be seated below the acromio-thoracic artery, an anastomotic arch may continue the circulation through the sac after operation; but this cannot be calculated on.

[4] Amer. Journ. of Med. Sc., 1845, vol. x., p. 13.

[1] Vol. ii., 1856; vol. i., 1860.

[2] An interesting case in which both subclavian arteries were successfully tied at an interval of three years, was published by Mr. Furner in Med.-Chir. Trans., vol. li.

aneurisms, both traumatic and spontaneous, which are amenable to gradual, intermitting pressure, when carefully applied to the artery above the tumor.

"2. That in cases where this is not possible, from the pain which the patient experiences on pressure, the application of rapid total compression, under anæsthesia, may effect a cure.

"3. That the ligature of the subclavian artery is so dangerous an operation, both from its own risks and the proximity of the sac, that it ought to be restricted to cases where pressure has failed, and to those in which, from the size and rapid growth of the axillary tumor, the surgeon thinks pressure unadvisable.

"4. That the old operation is to be preferred to the ligature of the subclavian in cases of ruptured artery; and that it may be practised in cases where, from the elevation of the shoulder or from the extent of the tumor, the surgeon would find it difficult to tie the subclavian, or fears in doing so to injure the sac; but that the anatomical relations of axillary aneurisms render this a peculiarly hazardous proceeding, and the surgeon should always be prepared to amputate if necessary. (Therefore, Mr. H. thinks a preliminary incision should always be made above the clavicle, through which the subclavian can be immediately secured in case amputation is resorted to.)

"5. That in very large axillary aneurisms, if any treatment be adopted, the arm should be amputated at the joint after ligature of the subclavian."

The cases that have been cured by pressure have required much patience and perseverance on the part of both patient and surgeon. In Dr. Peatson's case, quoted by Mr. Holmes, treatment was continued for three months. Esmarch's bandage has been used in one case unsuccessfully. Applied to the limb below the tumor, it would probably be a useful adjunct to pressure above.]

Aneurism at the Root of the Neck.

This is one of the most formidable diseases which can occupy the attention of the surgeon; both the diagnosis and treatment are surrounded with difficulties that are usually found insuperable. The main cause of this is the proximity of the heart. It is exceedingly difficult to distinguish whether the bruit is limited to the tumor or is propagated into it from the cardiac valves; whether the pulsation is limited to the neck, or extends also into the thorax; and whether one only of the large vessels is implicated, or whether others of the great arteries in the neighborhood, or the whole trunk leading from the heart, may not be diseased and dilated. Then in the treatment, the proximity of so great a stream of blood has hitherto prevented the successful application of a ligature upon the innominate or the first part of the subclavian, for the cure of aneurism situated above the axilla.[1] The atheromatous deposit, which generally, when it exists at all in these large arteries, involves their whole calibre to a very great extent, has sometimes even prevented the surgeon from tying the artery after he has exposed it; and the probability of the existence of this state of the vessel renders it always a hazardous matter to attempt an operation.

First, as to diagnosis. The aneurismal nature of the swelling does not usually admit of any doubt; for though here, as elsewhere, malignant tumors springing from the bones may derive pulsation from their own vessels, or tumors of any kind from proximity to the arteries, such sources of ambiguity are less common than in other parts of the body. Reference may therefore be made on the head of diagnosis between aneurismal and other tumors, to what has been said in the section on Diagnosis, and to what follows upon Abdominal Aneurism. But it is often a matter of great importance and of great difficulty to discover whether the aneurism involves the subclavian artery, or the root of the carotid, or the innominate, or more than one of these vessels, or the aorta by itself, or in conjunction with one of its branches. Mr. Wardrop[2] lays it down as a rule by which aneurisms of these several arteries may be diagnosed from each other, that when the disease affects the root of the carotid, it will present itself first in the small triangular space between the heads of the sterno-mastoid muscle; whereas when the innominate is the seat of disease, it will generally be found on the tracheal, and when the subclavian is affected, on the cervical side of that muscle. These observations can, however, only apply to cases even in the earliest period of the disease; and their deceptiveness even in such cases is shown by the fact that out of the few cases cited by Mr. Wardrop, one[3] proved to be of the innominate artery, which ought, according to his rule, to have been of the subclavian. But though the place of the first external appearance of the aneurism is not decisive as to the part of the artery from which it springs, it is a symptom of considerable importance, and should always be carefully noted when it can be clearly ascertained. Another important symptom is the character of the pulsation in the branches of the carotid and subclavian. If the pulse in the brachial or radial, or that in the upper part

[1] Except in one case, which will be referred to in the sequel, where the aneurism was probably traumatic.

[2] Op. cit., p. 83.

[3] Case of Gordon, ibid., p. 104.

of the carotid or the temporal, be materially less on the affected than on the sound side, we have some reason for believing the parent trunk (subclavian in one case, carotid in the other) to be affected; and in the opposite circumstances to be unaffected. But neither conclusion is free from some uncertainty. The growth of aneurisms in the cellular tissue of the mediastinum and root of the neck is so free, that instances have been observed of aneurisms of the arch of the aorta causing compression of the subclavian or carotid, without any disease of those vessels;[1] while on the other hand, if the aneurism approaches the tubular shape, the pulse may be unaffected in the branches, though the trunk is extensively diseased. Again, the influence of the anomalous distributions which so often affect the branches of the aorta is not to be forgotten.[2] Possibly some assistance to the diagnosis may be obtained by a careful consideration of the other organs compressed by the tumor. Thus pressure on the great veins will lead to lividity, or even a permanently cyanotic condition of the extremity[3] (hand and forearm, or face and scalp); pressure on the recurrent nerve, to laryngeal symptoms; on the phrenic nerve, to spasmodic action of the diaphragm; on the trachea, to stridulous respiration, etc.; but much caution is necessary in estimating these symptoms, which are common to thoracic aneurisms as well as cervical.

It will be seen from this extremely imperfect sketch, how difficult it is to determine, when an aneurism is situated low at the root of the neck, what or how great a part of the arterial tube is involved. The importance of a precise diagnosis consists in the fact that four great operations are recommended for such aneurisms, and that their applicability depends entirely on the limitation of the disease. 1. If the subclavian or carotid were alone involved, a ligature applied to the innominate artery would be analogous to the treatment adopted in other parts of the body. 2. If the aneurism were seated far down the subclavian on the right side, it might be possible to tie the first part of the artery itself, as indeed was done by Mr. Liston. 3. If the root of the carotid alone were implicated, a ligature on the distal side of the tumor (known as Brasdor's operation) might prove successful. 4. In aneurism affecting the innominate artery, it has been proposed to extend this method, and tie both the subclavian and carotid; while if the arch of the aorta were diseased, most surgeons would think any operation unjustifiable.

Assuming that the question of performing any of these grave operations is not entertained till a patient trial of judicious medical and dietetic means has been tried and failed, and that a thorough examination of the chest has given reasonable assurance of immunity from disease of the heart, lungs, and aorta, I will endeavor to state as succinctly as possible the conclusions to which I have been brought by observing a few cases, and reading the account of a good number.

1. The ligature of the innominate artery (Fig. 328) is an operation which has hitherto, except in a single case, only precipitated the fatal result impending over the disease, and which appears to afford less prospect of cure than the methods of general treatment which have been above indicated. But if these are obviously insufficient, it may in appropriate cases recommend itself to some surgeons.[1] It should never be performed, however, unless the artery can clearly be felt healthy behind the sterno-clavicular joint;[2] or the tumor is so plainly limited as to afford a very reasonable hope that it will be found so. In cases of tubular enlargement of a long tract of artery in the neck, it is worse than useless to expose an artery which will probably be found so diseased as either to prevent the operator from the attempt to tie it, or to give way and occasion fatal bleeding within a few hours if it is tied.

2. The ligature of the first part of the right subclavian artery (Fig. 329) is an operation which cannot be described in more favorable terms than that of the innominate, as far as its results go; but the indications are, perhaps, rather less perplexing,

[1] See cases by Allan Burns and A. Cooper, in Burns, On the Surgery of the Head and Neck, p. 60 et seq., 1844.

[2] I have seen a case in which, from other symptoms, there was no difficulty in diagnosing an aneurism of the arch of the aorta; but one circumstance was difficult to account for, viz., that while the pulse in the right carotid was unaffected, that in the right wrist was imperceptible. After death, that anomalous distribution was found in which the right subclavian is the last branch of the arch. Passing between the aneurism and the spine, it had been compressed, while the carotid was unaffected.

[3] Wardrop, op. cit., p. 162; Ogle, in Path. Soc. Trans., vol. x., p. 103; Bellingham, On Diseases of the Heart, p. 601; Allan Burns, op. cit., p. 68.

[1] See also Ligature of the Innominate Artery. Having regard to the successful issue of Dr. Smyth's case, it becomes a serious question whether the carotid and vertebral should not be secured in the same operation in which the innominate is tied. Further experience is necessary on this point.

[2] If the shape of the bones or joints is altered, it is clear that the aneurism arises in the thorax.

since a clear space ought to exist between the tumor and the trachea. Viewing, however, the anatomical difficulties of the operation, the doubt that must always exist whether the artery will be found healthy enough to unite as firmly as is necessary to bear the impact of so great a column of blood, and the great liability to secondary hemorrhage from the neighborhood of large branches, the operation seems so unpromising that most surgeons would prefer the plan by manipulation devised by Sir W. Fergusson, or galvanopuncture, dangerous and uncertain as these measures must be allowed to be. If this operation be attempted, the surgeon should take into mature consideration the possibility of securing, at the same time, some of the large branches.

[The first portion of the *left* subclavian was tied by Dr. J. Kearney Rodgers (see page 410), and in January, 1875, it was exposed by Arthur Fergusson McGill, and compressed with torsion forceps for ten hours. Unfortunately the pleura was wounded, and the patient died on the sixth day in consequence. The aneurism was found filled with a hard, firm clot. (Med.-Chir. Trans., vol. lviii., p. 337.) Prof. Van Buren, referring to these cases (loc. cit., p. 558), expresses the opinion that the operation may be undertaken with propriety if the catgut ligature is used.]

3. Brasdor's operation for securing the artery on the distal side of the tumor is applicable, and applicable almost exclusively, to aneurisms affecting the lower part of the common carotid artery; in which, from the equality of the radial pulse on the two sides, the distinct limitation of the tumor, the freedom from œdema of the arm and hand, and the absence of murmur in the aorta or subclavian, there is reason to believe that the affection is confined to the common carotid. In such cases, it would be reasonable to commence the treatment by applying digital pressure to the artery, in the position in which it is intended afterwards to tie it.

4. The double distal ligature, *i. e.*, the ligature of the subclavian and carotid for aneurism of the innominate artery, has been performed in a few cases, of which a list will be found on a subsequent page. As far as the experience of these cases enables one to judge, it appears that this operation is justifiable in favorable cases of aneurism in which the innominate artery is believed to be alone implicated, and in which the main symptoms are those of pressure on the trachea and œsophagus.

[Simultaneous ligation of the carotid and subclavian arteries for innominate aneurism has been repeatedly done during the last ten years, and with a certain degree of success; and since the publication of this essay Mr. Holmes himself (Lancet, 1876, i., p. 426), as well as other surgeons, has tied the left carotid for aneurism of the arch of the aorta with marked relief of symptoms. He says (Lancet, 1872, ii., p. 326), "With respect to the ligature of the left carotid for aneurism of the arch of the aorta, I have no doubt that there are cases in which it is very beneficial, though there are no theoretical grounds for believing that a cure can be effected by this operation. . . . Nevertheless, in all these cases, the relief from the operation was so marked as completely to justify the course pursued.

"I conclude from the analogy of the other cases of distal impaction which I have produced, that the benefit in these instances depends upon diminution of the size of the tumor consequent upon the obliteration of that part of the sac which was previously distended by the current of blood passing into the left carotid. The operation, therefore, holds out definite prospects of benefit in all cases in which the growth of the tumor can be traced upwards, towards the trachea on the left side, and by parity of reasoning, the distal operation on the right side is equally indicated when the growth is on the opposite side of the windpipe."

In the discussion which followed the report of his own case he said (Lancet, 1876, i., p. 427) that "whilst he believed that ligature of the carotid or innominate was of use when the aneurism was ascending along them, he did not believe there was any advantage to be gained from ligature of the subclavian in its third part."

In two cases the right carotid and subclavian in its third part have been recently tied for aneurism of the arch of the aorta, and in one case for the same affection thought to involve the innominate also. In the first (Barwell, Med.-Chir. Trans., vol. lxii., p. 393; and Wyeth, Am. Journ. Med. Sci., January, 1881, p. 160) the patient lived for fifteen months, apparently much relieved by the operation; and at the autopsy the aneurism, position not stated, was found filled with laminated coagulum. In the second (Lediard, Brit. Med. Journ., Dec. 4, 1880) the patient's condition was very critical for a few days after the operation, but he recovered. The symptoms were relieved for six and a half months, when there was a return of sharp pain and pulsation, continuing a week later, when the report ends. In the third case (Wyeth, loc. cit., p. 156) the carotid incision was still open ten weeks after the operation, and the tumor was smaller than it was before the operation, but larger than it was five days after it; relief of pain seems to have been the main benefit obtained.

Mr. Barwell (loc. cit.) bases this method of treatment upon a consideration of the relations between different portions of the stream

in the ascending aorta and the orifices of the cervical branches. He divides the wall of the ascending aorta into two districts, "separated from each other by a somewhat curved line running from the outer or right side of the aortic opening to the left carotid orifice. Thus to the right district will belong the right wall of the ascending aorta, and on the back and front wall a semilune, one of whose horns is at the outer valve, the other at the left carotid opening. Any operation for an aneurism in this district should be on the right vessels. The left district includes the left wall, a considerable adjoining space on the front and back of the ascending aorta, and all the transverse aorta from the left carotid opening." For aneurism in the left district he would tie the left carotid.]

In the sections which describe the treatment of aneurism by manipulation, by coagulating injections, and by galvano-puncture, the reader will find sufficient data to guide him in forming an opinion as to the propriety of using those measures in any given case of aneurism in the neck.

Brasdor's method will be found described on a subsequent page, together with other operations on the common carotid artery. It remains only to describe the operations on the first part of the subclavian and on the innominate artery.

In order to secure the *first part of the right subclavian artery*, as in the operation on the innominate, the root of the carotid is to be exposed and traced down to the bifurcation. The external incisions and superficial dissection are therefore the same for both operations. An incision should be made along the upper border of the clavicle, a director passed under the sternal border of the sterno-mastoid muscle, and the whole or the greater part of the muscle separated from the sternum and clavicle. An incision should also be made upwards along the inner edge of the muscle, and the whole flap containing the divided muscle should be reflected outwards. The sterno-hyoid and sterno-thyroid muscles now come into view, and may be drawn aside with a blunt hook, or cut across. This will expose fully the sheath of the carotid vessels—the internal jugular vein on this side inclining away from the artery, so as to leave an interval in which the pneumo-gastric nerve is to be found. If now the operator desires to secure the first portion of the subclavian, he must remember that the only part of it sufficiently free from important relations to admit of the operation is the small portion bounded by the pneumo-gastric nerve on the inner side, and the thyroid axis with the phrenic nerve on the outer side. The former nerve therefore is to be taken as the guide; and, the carotid artery having been traced down to the bifurcation of the vessels, the subclavian is to be followed outwards till the pneumo-gastric nerve is recognized by the finger. The ligature will then be most readily passed with a probe curved abruptly, or a needle more bent than usual, introduced from before backwards.

Ligature of the left subclavian in the first part of its course.—I have been favored, by the kindness of Dr. Lewis A. Sayre, of New York, with the particulars of the case in which Dr. J. Kearney Rodgers of that city tied the left subclavian artery within the scalenus muscle. The case will be found detailed in the New York Journal of Medicine for 1846.

The patient was a man aged 42; the disease had existed for four months, and formed a pulsating tumor the size of a small hen's egg, rising about two inches above the left clavicle, extending externally to the outer third of the bone, and internally covered by the outer edge of the sterno-mastoid muscle. The cutaneous veins were very much enlarged over it. He was troubled with severe pain, preventing sleep, down the course of the nerves of the brachial plexus, and the arm and hand were œdematous. The pulse was unaffected. He was kept under treatment, chiefly by means of venesection and digitalis, for a month, but the tumor steadily increased, and the man's sufferings were so acute as to render him anxious to submit to any operation, however dangerous. At a consultation, the surgeons present, of whom Dr. Mott was one, declined to recommend the operation, but left it to Dr. Rodgers's judgment, who operated on October 14, 1845.

He thus describes the operation:—

"An incision was made three inches and a half in length on the inner edge of the mastoid, terminating at the sternum, and dividing the integuments and platysma myoides.

"This was met by another extending along the sternal extremity of the clavicle, about two and a half inches. This last incision divided a plexus of varicose veins passing, in the integuments covering the clavicle, to the subclavian. Free bleeding taking place from their cut and patulous extremities, it became necessary to check it by ligature.

"The flap of integuments and platysma myoides was now dissected up, and the lower end of the mastoid laid bare; a director was passed under this muscle, and the sternal portion and half of the clavicular divided by the bistoury. This muscle was now turned up, and the sterno-hyoideus muscle, the omo-hyoideus, and the deep-seated jugular vein were seen covered by the fascia.

"On turning up the mastoid, a portion of the aneurismal sac strongly pulsating was brought into view, overlapping about half the width of the scalenus, forming now the

outer part of the track through which I was to pass; showing fearfully one of the dangers of the operation, which, from my previous examinations of the part, I had of course anticipated.

"The fascia being divided by the handle of the scalpel and the fingers, I passed in contact with the deep jugular on its outer side to the inner edge of the scalenus anticus, intending, for the purpose of avoiding as much as possible all danger to the thoracic duct, to reach this muscle fully half an inch above the rib, rather than at its insertion. I now felt distinctly the phrenic nerve running down on the anterior surface of the scalenus, and was confident that I should be able to avoid any injury to it. Having attained the inner edge of the scalenus anticus by pressing downwards with the finger, I soon discovered the rib, and after some little search easily found the subclavian artery. By pressing it against the rib, all pulsation ceased in the tumor, and by removing the finger pulsation returned.

"I now felt that great care was necessary to detach the artery, and avoid danger to the pleura and thoracic duct. In accomplishing this part of the operation, I at first tried Sir Philip Crampton's instrument, but ascertaining that I could better carry the ligature around the artery, and bring up its end, by the invention of Drs. Parrish, Hewson, and Hartshorne, of Philadelphia (long since given to the profession by them, and lately claimed by Mr. L'Estrange, of Dublin), I accordingly adopted that instrument.

"This part of the operation, it will be imagined, was not very readily accomplished. The great depth of the vessel (nearly the length of my finger) and narrowness of the wound, prevented a very easy management of instruments. The point was introduced under the artery, and soon directed upwards so as to avoid injury to the pleura. I readily tied the ligature, and tightened it with the forefinger in the bottom of the wound. All pulsation immediately ceased in the aneurism and the arteries of the extremity.

"The patient complained of no pain or unusual feeling in the head, as might have been expected from so suddenly changing the current of so large a quantity of blood."

He went on well, with the exception of a slight erysipelatous attack, until the tenth day (October 23), when a cough came on, and he complained of flashes of light before his eyes; the left pupil was noted as being contracted; and on the following day ptosis came on on that side. Secondary hemorrhage commenced on the thirteenth day, and proved fatal on the fifteenth.

Post-mortem examination, eighteen hours after death.—The wound was filled with coagula and sponge, which had been introduced for the purpose of making pressure. The blood was already in a state of partial decomposition.

The dissection was carefully performed, exposing the different layers of the muscles. The lower incisions made at the operation were found to include three-fourths of the mastoid, leaving a small portion of the clavicular portion undivided.

Below this the aneurismal sac and the scalenus anticus formed the outer and posterior wall of the wound. The inner wall was formed of condensed cellular tissue covering the carotid artery, jugular vein, thoracic duct, and the edges of the thyroid muscle.

At the bottom was the subclavian artery, completely divided by the ligature, which was found free in the coagula. The cellular tissue of all the parts around the wound was condensed by adhesive inflammation, rendering the dissection exceedingly tedious and difficult. The jugular vein, which skirted the inner wall of the wound, was obliterated and filled with fibrinous coagula.

Opposite the track of the ligature the vein was contracted to a cord, and impervious as far as its junction with the subclavian. The vena innominata and subclavian were normal.

The pleura at the bottom of the wound presented a large irregular lacerated opening, communicating from the wound with the left pleural cavity, which was filled with coagulated blood. This formed one large uniform coagulum, and had every appearance of being of rapid and recent formation; the membrane around was thickened. On exposing and tracing the subclavian artery, it was found that the ligature had been applied about one and a quarter inches from its origin at the aorta, and immediately at the root of the vertebral, on its cardiac side. The artery had been completely divided by the ligature, which, as mentioned above, was found loose in the wound. The stump of the subclavian, between the aorta and ligature, presented the appearance of a round solid cord, about an inch and a quarter long, and impervious to liquids and air.

The external coat of the stump was thickened and adherent near the ligature to the surrounding tissues, by adhesive inflammation. On laying open the vessel longitudinally, it was found that a firm fibrinous coagulum occupied the vessel, and was adherent firmly to its inner coat for three-quarters of an inch; near the aorta, the coagulum was softer. The coats of the vessel were moderately thickened, and presented a small patch of atheromatous deposit about the third of an inch from the tied end. Around this deposit the adhesion seemed as perfect as at any other part.

Beyond the ligature the artery presented a different appearance. No plug other than a soft coagulum of blood occupied its cavity, and it presented much less evidence of adhesive inflammatory process in its coats. The vertebral was given off immediately at the point of ligature, and was open, containing a thin blood coagulum like the one in the subclavian. These were drawn out with ease, and evidently had formed during the last moments of life.

About one-third of an inch from the verte-

bral was the internal mammary. These vessels were all patulous and healthy. About half an inch from the thyroid axis commenced the dilatation of the artery to form the aneurismal sac.

This tumor was about the size of a small orange, and had involved in its growth part of the scalenus anticus, the cervical nerves going to form the cervical plexus, the surrounding cellular tissue, and the glands. The aneurism was completely blocked up with coagula, and the axillary artery, which emerged from its distal side, was plugged with a fibrinous clot exactly similar to the one in the stump of the subclavian, though perhaps not so perfect. It appeared sufficiently so, however, to obliterate entirely the calibre of the vessel. The plug extended some distance down the axillary artery.

The thoracic duct, which had been injected with wax from the abdomen, was found uninjured. The aorta was thickened, and its coats irregular from a considerable deposit of atheromatous matter in its tissues.

The heart was somewhat larger than natural, but apparently sound. The other organs were not examined.

Dr. Rodgers's observations on this most interesting and important case are well worthy of perusal. They are as follows:—

"Although a decided majority of the consultation agreed as to the propriety of the operation of securing the artery for aneurism, still, as my colleagues kindly left it with me to decide whether it should be undertaken, I felt it incumbent on me to investigate the subject with great care, and accordingly gave it my most sedulous attention. I was the more anxious, because, in the only case in which the attempt had been made by Sir Astley Cooper, in 1809, that eminent surgeon failed to secure the vessel, and is said to have entertained apprehensions that he had wounded the thoracic duct.

"I had always considered it as a perfectly justifiable operation, and one that a careful surgeon conversant with anatomy could accomplish, if the tumor were of moderate size.

"The want of success in the four or five operations on the right subclavian in its first stage did not discourage me, nor did they alter my opinion.

"The difference in the anatomy of the right and left arteries was so very great that I did not consider it fair to argue that a similar result was to follow on the left side.

"The greater depth of the left, indeed, rendered the operation more formidable; but, if accomplished, not less likely to succeed.

"The point where the ligature must necessarily be applied on the right side is but a quarter or at most half an inch from the innominata and the coming off of the carotid, so that it could scarcely be expected that a coagulum would form sufficiently firm to adhere to the vessel, and resist the force of the heart's action. Besides, too, the greater force of the circulation on the right side was additionally unfavorable to success on that vessel, and, therefore, is an additional reason for distrusting an argument drawn from a parallel between the two.

"In examining anatomical and surgical authorities, I found the opinion prevalent among almost all British authors that the operation on the left side was 'impracticable.'

"Colles, the eminent Irish surgeon who first tied the right subclavian in its first stage, says: 'This operation, difficult on the right, must be deemed impracticable on the left subclavian. For the great depth from the surface at which this vessel is placed, the direct course which it runs in ascending to the top of the pleura, the sudden descent which it makes from this to sink under the protection of the clavicle, and the danger of including in the same ligature the eighth pair of nerves, the internal jugular vein, or the carotid, which all run close to and nearly parallel with this artery—these all constitute such a combination of difficulties as must deter the most enterprising surgeon from undertaking this operation on the left side.' Edinburgh Med. and Surg. Journal, Jan. 7, 1815, p. 23.

"Harrison,[1] Flood,[2] Guthrie,[3] and Quain[4] all coincide in this opinion.

"The opinions of those eminent anatomists and surgeons being so decidedly against the possibility of the operation, it was only left for me to examine with great care the surgical anatomy of this vessel.

"Having had the thoracic duct injected with wax, I repeatedly dissected the parts concerned, and operated in every way that suggested itself to me as likely to present any advantage.

"My opinion of its feasibility was thus confirmed, and having never entertained any doubts of its propriety, I accordingly undertook it.

"I regret, indeed, deeply, the death of my patient; but the appearances presented on examination after death have only strengthened the opinion I had previously formed, and have encouraged me to undertake it, with some slight variations, should another case ever present itself.

"It has often happened with important operations that many of the first cases have been unsuccessful, while the carefully noted observations made on dissection have led to different modes of operating, and more uniform success.

"Previously to the performance of this operation, many entertained doubts whether the force of the circulation so near the heart in so large a vessel would not prevent the formation of a coagulum, and of course inter-

[1] On the Anatomy of the Arteries, vol. i., p. 125. Dublin, 1833.

[2] The Surgical Anatomy of the Arteries, p. 84. London, 1839.

[3] On the Diseases and Injuries of the Arteries, etc., p. 396. London, 1830.

[4] Anatomy, 3d edition, p. 492. London.

fere with the obliteration of the vessel. These doubts have now been removed, and I consider that all reasonable objections fall with them, except those arising from the anatomy.

"Danger to the thoracic duct and pleura are, in my opinion, the most serious of these; for, with ordinary coolness and care, there will be little danger of including the pneumogastric and phrenic nerves, or carotid artery, in the ligature. The veins may be lacerated by great roughness, but can scarcely be included.

"The thoracic duct, I think, can almost always be avoided by reaching the inner edge of the scalenus half or three-quarters of an inch above its insertion, and then pressing the finger down towards the rib. The duct is thus kept out of the way of laceration by the finger, and afterwards by the aneurismal needle. I am aware that this duct varies in its course, but this direction I am confident will usually secure its safety. By adopting it in the many times I operated and dissected the parts in the dead body, it was uninjured.

"The artery lies in contact with the pleura, the laceration of which might be attended with very distressing and dangerous consequences.

"A careful introduction of the aneurismal needle, and soon turning up its point, will usually secure the safety of this membrane. In none of my operations on the dead body, where it was performed in this way, was it injured.

"The hemorrhage in this case came from the distal end of the artery, and the very free and direct anastomosis of the internal carotid at the base of the brain with the vertebral, induce me to think that it was the latter vessel which transmitted the blood. Some, indeed, may have come through the thyroid axis, but I consider the former mode more direct.

"Should this operation be repeated, I would suggest securing the vertebral, and if possible the thyroid axis, by ligature.

"The difficulties are indeed thus increased, but not insurmountable."

I have had the greatest pleasure in laying the history of this case (which is too little known in England) before the readers of this work. Whether it justifies the operation in any given case must still be a matter of individual opinion. It certainly shows the opinion ordinarily entertained of the impracticability of the operation to be erroneous; but we cannot avoid seeing that the difficulties, and even the anatomical dangers of the operation (terrible and almost insurmountable as these latter are[1]) do not exhaust the objections to the proceeding. For in this, as in all previous cases which survived those dangers, the cause of death has been secondary hemorrhage. Dr. Rodgers's suggestion of tying the large branches which come off near the distal side of the ligature, is eminently worthy of trial. Still more is it to be hoped that some method may be found for obliterating arteries without dividing them. If the latter desideratum could be realized, I should expect the ligature of these great arteries (innominate, first part of subclavian, are possibly abdominal aorta) to take its place among the recognized and successful operations of modern surgery.

If *the innominate* is to be tied, the operator must follow down the line of the carotid artery into the thorax, when he will find the end of the vessel behind the sterno-clavicular joint, and must get the ligature round it as best he can—perhaps the most difficult part of the whole operation, since great veins lie close to the artery, the slightest wound of which may give rise to fatal hemorrhage, and the parts are probably quite out of sight.

On the dead subject, the innominate may be reached without any such extensive dissection, by exposing the root of the trachea with a sufficient incision, and running the finger down it into the thorax, where the artery will be felt crossing the air-tube obliquely; but in the living body I should think the greater freedom and better view of the parts obtained by the division of the muscles at the root of the neck would render the operation above described preferable.[1]

The innominate has also been reached from the front, by removing the end of the sternum and the sternal end of the clavicle. Two cases were operated on after this manner by Dr. Cooper, of San Francisco,[2] the aneurism affecting in both cases the carotid and subclavian arteries, while in one at least the end of the innominate itself was diseased. The first patient died a few days after the operation, his death being hastened, it is said, by disease of one kidney. In the second case hemorrhage had occurred, but the patient was going on well, when he tore off the bandages from his wound, with

[1] In this very case, if I read the account right, the probability is that the pleura was opened during life. It is true the pleura has been known to have been opened in operations on the subclavian arteries in cases which have nevertheless proved successful (vide p. 406).

[1] It is usual in speaking of the ligature of the innominate artery to describe various contrivances for carrying a ligature round it. I have not found on the dead subject that they are superior to the simple aneurism-needle, nor have I seen any case in which they have been used on the living. Mr. Syme, in speaking of the ligature of the common iliac artery, says that, in his judgment, "the simplest form of needle is the best." (Obs. in Clinical Surgery, p. 169.)

[2] Amer. Journ. of Med. Sc., Oct., 1859.

the intention of destroying himself, and perished of hemorrhage on the thirty-fourth day.[1]

The innominate artery has now been tied more than a dozen times. Mr. Erichsen tabulates thirteen cases, including the last published case under the care of Smyth. M. Le Fort,[2] who omits one of Mr. Erichsen's cases, adds two others said to have been operated on by Bujalsky, which Mr. Erichsen discredits. There is likewise another operation which is said to have been performed by Pirogoff, and all these cases are received by Dr. Pilz. If we received all these as authentic, we should have sixteen or seventeen operations—one of which only proved successful. In that case[3] the innominate and carotid were tied simultaneously by Dr. Smyth, of New Orleans, for subclavian aneurism, referred to an injury received about three months before. Secondary hemorrhage occurred fourteen days afterwards. The wound was then plugged with small shot and the ligature on the innominate was "pulled away, even against some resistance." The tendency to hemorrhage was kept in check for more than a month by the compression of the shot, when it recurred with great violence. The vertebral artery was then tied. This was followed by marked decrease in the circulation of the arm, and the brachial artery became occluded. The radial pulse, however, returned after a few days. All went well after this last operation, and the patient at the date of the report (four months after operation) was perfectly well, except that he had not completely regained the use of his arm.

In four cases the artery has been exposed, but found so diseased that the operator has not dared to tie it. In one of these cases (Porter's) the disease afterwards underwent a spontaneous cure.

A case is reported in vol. xix. of the Bulletin de l'Académie Imp. de Méd., p. 454, in which M. Peixoto, of Brazil, is said to have tied the innominate with a "ligature d'attente," removed on the twelfth day, for hemorrhage from an erectile tumor of the ear, coming on before the separation of a ligature which had been placed on the common carotid. The patient recovered completely. There is no proof, however (as M. Velpeau, the reporter for the Academy, observes), either that the innominate was really tied in this case, since the ligature might have been placed under the root of the carotid, or if tied, that it was obliterated.

A case should also be referred to, under the care of Dr. Porter, of Dublin,[4] in which acupressure was used to the axillary artery, and followed by pressure on the innominate, by means of a screw instrument with two blades, one blade resembling an ordinary aneurism-needle, and the other blade made to screw down on to the former. This was kept for three days under the artery, and then removed. Pulsation immediately returned in the tumor, which soon afterwards burst, and the patient died.

The operation on the first part of the subclavian has been hitherto uniformly fatal. Eleven cases are on record;[1] the cause of death was hemorrhage in every case which survived long enough. In one (Mr. Partridge's) the patient died on the fourth day from pleurisy and pericarditis. If the surgeon should trust himself to perform this operation, it would undoubtedly be his duty, remembering Dr. Smyth's and Mr. Liston's cases, to endeavor to guard his patient from secondary hemorrhage by tying the carotid and vertebral at the same time. But it must always remain in the highest degree doubtful whether such an operation would not be more dangerous even than the disease it is intended to cure. Sir W. Fergusson has proposed to treat aneurism at the root of the neck which resists less heroic measures, by amputating at the shoulder-joint, trusting that the (distal) ligature of the axillary artery on the face of the stump would cure the aneurism now that the limb is removed, and so no need exists for a collateral circulation. The only published case in which this operation has been tried is Mr. Spence's, which is added to Mr. Poland's paper on indirect digital compression for the cure of subclavian aneurism (Med.-Chir. Trans., vol. lii., p. 306). In that case the limb was threatened with gangrene, which made the indication for amputation more plain than it would have been in any ordinary case. The patient survived the operation about four years; the cause of death was not exactly known, but it appears to have been due to the growth of the aneurism. The latter was of the tubular variety. It diminished in size after the amputation, but there was no proof of any coagulation of its contents. The operation must be a most dangerous one to a patient laboring under disease of the great vessels, and the cure of the disease by it highly doubtful.

[In November, 1878, Mr. C. Heath amputated at the shoulder-joint for an aneurism of the third portion of the left subclavian. No apparent benefit resulted, and two months afterwards he inserted needles into the sac. (See p. 378.) In the discussion that followed the report of the case in the Med.-Chir. Society (Lancet, 1880, i., p. 168), it was stated that amputation at the shoulder had been done four times for this disease, with apparent bene-

[1] Erichsen, Science and Art of Surgery, ii., 118.

[2] New Syd. Soc. Biennial Retrospect for 1865–6, p. 351.

[3] New Syd. Soc. Biennial Retrospect for 1865–6, p. 346; from the New Orleans Med. Record.

[4] Dublin Quarterly Journal, Nov., 1867.

[1] Erichsen, op. cit., ii., 122.

fit in only one case, that of Mr. Spence's above-mentioned. Since then it has been done once, together with ligature of the carotid, for aneurism of the right subclavian, probably involving the innominate, by Mr. Rose, at the Royal Free Hospital. (Brit. Med. Journal, 1880, i., p. 924.) The operation was done antiseptically, and three weeks afterwards it is reported that the carotid wound was healed, the amputation wound almost healed, the aneurism reduced to one-third its original size, and the patient free from pain. A report of the subsequent history of the case was promised, but I have not been able to find it.]

In one case (referred to on p. 402, note), subclavian aneurism has been successfully treated by digital pressure above the tumor, but there were peculiar anatomical conditions in that case which cannot be expected to be again met with.

[Dr. Warren Stone (New Orleans Med. and Surg. Journal, July, 1875, quoted by Prof. Van Buren, loc. cit., p. 554) cured a traumatic aneurism of the second portion of the left subclavian by *distal* digital pressure applied to the third portion of the artery for 39 hours. At the expiration of that time the tumor had diminished one-half in size, was much harder, and its pulsation feebler. It continued to diminish, and in 9 months all pulsation had disappeared. In May, 1876, nearly two years after the operation, the tumor was reduced to a pulseless, barely recognizable lump.]

Ligature of the *vertebral artery* was performed by Dr. Smyth, of New Orleans, for secondary hemorrhage, in the case of ligature of the innominate and carotid above mentioned. The operation is performed in the following manner:—[1]

The head of the patient being thrown backwards and turned slightly to the left, an incision two inches long was made from a little above the clavicle along the posterior border of the sterno-mastoid muscle. The edge of this muscle having been exposed and drawn aside, the prominent anterior tubercle of the transverse process of the sixth cervical vertebra was readily felt, and taken for a guide—the artery lying vertically below it. A layer of fascia was divided, some loose cellular tissue with lymphatics and the ascending cervical artery were pulled to the inner side; the scalenus anticus and longus colli muscle were separated from each other close below their insertion into the tubercle, when the artery and vein became visible. The vein was drawn to the outer side (a point of importance, according to Dr. Smyth), and the needle was passed round the artery from without inwards. Dr. Smyth remarks that when the artery enters the foramen in the fifth transverse process, it is more readily found. In one case which he dissected he found it entering the foramen of the seventh vertebra. In Dr. Smyth's case the operation was much facilitated by the empty condition of the vessels consequent on the previous hemorrhage.

Dr. Parker, of New York, also tied the vertebral artery simultaneously with the carotid and subclavian (its first part) in a case of subclavian aneurism. The patient died of hemorrhage, and on post-mortem examination it was found that both the central end of the subclavian and that of the vertebral were opened by ulceration.[1]

[In his Lectures (Lancet, 1873, ii., p. 105), Mr. Holmes says that while no case of spontaneous aneurism of the vertebral artery in the neck has been reported, yet there are 12 cases on record of wound or traumatic aneurism of that vessel, in each of which an erroneous diagnosis was made as to the artery involved, and in 10 of which the carotid was tied with a fatal result. In the remaining 2 the carotid was exposed, but the ligature was not tightened because it was found that pressure upon the artery did not arrest pulsation in the tumor: in one of these two the patient died from hemorrhage, in the other spontaneous cure, aided only by the application of cold, took place. The cessation of pulsation was preceded by very severe pain.

After discussion of the means by which this error in diagnosis may be avoided, and of the proper treatment to be pursued, Mr. Holmes states the following conclusions:—

"1. A traumatic aneurism may be taken to be vertebral when it is situated in the course of that vessel, and when its pulsations are not commanded by compression of the lower part of the common carotid.

"2. When a traumatic aneurism is situated as above, and its pulsations are commanded, however completely, by pressure on the common carotid low in the neck, it ought not to be treated as being carotid, or as affecting a branch of the carotid, unless it is clearly proved that its pulsations are stopped by pressure applied above the level at which the vertebral ceases to be compressible—*i. e.*, above Chassaignac's 'carotid tubercle' (the anterior tubercle of the transverse process of the 6th cervical vertebra).

"3. An aneurism diagnosed as vertebral may be treated by compression (gradual or rapid, as the case demands) of the root of the vertebral artery in the neck, if this is found feasible.

"4. If indirect compression will not stop the pulsation, or if it cannot be borne, the tumor should be subjected to direct compression, and refrigeration, to which internal remedies may be added; and possibly the subcutaneous injection of ergotine may be of use." (Quite recently Mr. Holmes said (Brit. Med. Journal, 1880, i., p. 205) that he had tried the injection of ergotine six or eight times, and had found it useless.)

"5. If these means fail, and the tumor appears likely to burst, or if it has burst, the sac should be opened with due precaution,

[1] This method of operating will be found described in Mott's Velpeau, vol. ii., p. 229.

[1] Am. Med. Times, March 5, 1864; Am. Journ. Med. Sc., 1864, p. 562.

and an attempt made to tie or plug the wounded artery.

"6. A wound known or suspected to be of the vertebral artery should be treated either by direct pressure or by ligature of the vessel in the wound."]

Brasdor's Method of Treating Aneurism.

Brasdor was, it is said, the first to propose the operation which has ever since gone by his name, viz., the ligature of an artery affected by aneurism on the distal side of the tumor, or that farthest from the heart, instead of the usual plan of tying it between the heart and the tumor. Brasdor, however, has left no written account of his proposition, nor did he ever put it in practice. It was renewed by Desault, and he has left us a notice of it in his works.[1] The first person to act upon the suggestion was Deschamps, in a case of femoral aneurism; but his operation was undertaken on such mistaken principles, and was conducted so unsuccessfully, that little use can be made of it. Sir Astley Cooper[2] tied the femoral artery below an aneurism in the groin, which appeared to him to have extended so far up as to render the application of a ligature above the tumor impracticable. It seems, however, from the terms in which this operation is spoken of, that it was only intended as a temporary expedient, and that Sir A. Cooper expected from it merely such a diminution in the size of the tumor as would render it afterwards possible to apply a ligature in the ordinary way. In this he was disappointed, for the tumor continued to extend upwards, and burst under the peritoneum.

With the resources that modern surgery possesses, and, it may be added, with the knowledge we now possess of the very grave dangers attending on ligature of the large vessels, such operations as those above alluded to would be universally repudiated. There is no such reasonable probability of curing an aneurism of any large artery of the limbs by distal ligature as would justify a surgeon in exposing his patient to the risk of the operation.

There is, however, one situation in which the operation has been successfully performed, and in which it will be perfectly justifiable to repeat it, at least until some more certain and safe means of cure can be suggested; viz., in aneurisms of the carotid artery at the root of the neck. Mr. Wardrop[1] was the first to show the practicability of this proceeding, and he operated successfully upon a carotid aneurism of recent origin in a lady aged seventy-five. To him also must be conceded the merit of showing the difference in principle between the operation as practised upon the carotid and upon the arteries of the limbs. The difference depends simply upon the fact that no branches are given off by the carotid artery in any part of its course; so that, for this purpose, the whole of the vessel may be regarded as part of the aneurismal sac, and a barrier at any part of the artery will stop the circulation through the tumor. This at least is the case if the aneurism be not situated so near to the subclavian (on the right side) as to share in the circulation of that vessel; but such a tumor would be almost as much an aneurism of the subclavian as of the carotid. On account of his success in this instance, and his work written to recommend this form of operation,[2] Mr. Wardrop's name is frequently associated with the method of distal ligature.

Wardrop pointed out plainly the difference in the method of Brasdor as applied to carotid and other aneurisms—viz., that in the former no branch intervenes between the aneurism and the ligature; and he related four cases of carotid aneurism so treated, "proving indisputably," as he said, "that the future growth of an aneurismal tumor may be arrested, and its parietes consolidated, by placing a ligature on an artery on the *distal* side of the sac, when no branch intervenes between the sac and the ligature" (op. cit., p. 53). He goes on from this point, which he believes himself to have demonstrated, and the demonstration of which is I think quite satisfactory, to state that in his opinion the same method may also be pursued in cases where the artery is differently situated, *i. e.*, where branches do intervene between the aneurism and the ligature, as in the cases where the carotid artery alone, or the subclavian and carotid simultaneously, are tied for aneurism of the innominate. But here I cannot think Mr. Wardrop's facts or reasonings are at all conclusive. He gives one case (that of Mrs. Denmark) in which he tied the subclavian artery for innominate aneurism, the carotid being so compressed that he judged it to be impervious, which, however, it was not. The patient survived some time, and evidently derived benefit from the operation, but the disease seems not to have been really cured.

[1] Œuvres chir., vol. ii., p. 568.

[2] Hodgson, op. cit., p. 301. Mr. James, of Exeter, performed a similar operation on the patient in whom he afterwards secured the aorta, and attributed to the distal ligature of the femoral a certain amount of diminution of the tumor.—Med.-Chir. Trans., vol. xvi., p. 1.

[1] Med.-Chir. Trans., vol. xiii., p. 217.

[2] On Aneurism. London, 1828.

Mr. Wardrop also mentions the case operated on by Mr. Evans, of Belper, by ligature of the carotid alone, in which the symptoms of impaction of clot in the subclavian artery were very obvious (see below, p. 420).

In the American Journal of the Medical Sciences, vol. xiv., p. 22, will be found a table by Dr. Norris of fifteen cases in which the carotid artery was tied on Brasdor's principle.[1] Of these fifteen, four are admitted to have died of the immediate effects of the operation: and to this number the third case in the table[2] ought certainly to be added, and perhaps the sixth also. At any rate, we shall probably not err much in representing the mortality of Brasdor's operation on the carotid artery at one-third of the number of cases. Of the fifteen cases, four only are said to have been cured by the operation. All of them appear to have been aneurisms of the carotid, unless one should be excepted (No. 5), in which the innominate was thought to be affected; but, as this case recovered, the diagnosis was of course not absolutely confirmed.[3] Dr. C. Pilz has given a table of thirty-eight cases, in which, according to his classification, the carotid artery has been tied on Brasdor's method. However, the value of that table will be found to be much diminished by the fact that Dr. Pilz has mixed together cases in which the ligature of the carotid was the main operation, and which were performed strictly on the principles laid down by Wardrop, with others in which (as in Liston's and Smyth's cases) the main operation was the ligature of the trunk between the tumor and heart, and that of the carotid was merely a precaution against the reflux current. Nor is Dr. Pilz's collection by any means free from errors. Out of the thirty-eight cases, twelve only recovered, twenty-five died, and in one the issue was uncertain. A careful examination of Dr. Pilz's table will, I think, convince any person that the reality of cure or even of improvement in many of the twelve cases which recovered from the operation, is not only not proved, but is highly improbable. I refer especially to the cases marked 553, 559, 564, 566, 583, 586. If we take these statistics as being correct, which we are obliged to do in the want of more extended experience, it is abundantly plain that the risk of the operation is counterbalanced by a rational probability of success only when the aneurism is seated upon the carotid itself, and does not share in the pulsation of the subclavian. The above amount of success is, however, quite enough to justify the adoption of the method in any such case, where the attempt to tie the artery on Hunter's principle would be impracticable or even attended with unusual danger.

One circumstance, which seems to occur pretty generally though not universally in these cases, testifies very strongly to the activity of the efforts of nature to cure the disease. It is that the pulsation in the tumor is usually not increased, but, on the contrary, often much diminished, by the ligature of the vessel beyond it. In almost all the cases related in Mr. Wardrop's book, the tumor was observed to diminish both in size and pulsation immediately after the operation; a result which could only have been due to the rapid increase in size of the branches below the tumor, by which the course of the stream of blood was diverted from the aneurism.

Aneurism of the innominate artery and other aneurisms at the root of the neck have also been treated by the distal ligature, sometimes of the carotid and subclavian simultaneously, at others of the same arteries with an interval between the two operations; of the former, four operations are on record, of the latter three. In each class one case of cure is claimed.

Mr. Fearn, of Derby,[1] tied the carotid on August 30, 1836, and the third part of the subclavian on August 30, 1838, on account of an aneurism of the innominate artery. The patient recovered from both operations, and died four months after the ligature of the subclavian, from a cause unconnected with the operation or the disease. I append a representation of the parts, which are preserved in the Museum of the Royal College of Surgeons (fig. 330).

It is impossible to doubt that in this case a cure temporarily at any rate has been produced by the operations employed. The doubts expressed on that point in the first edition of this work, resulted from a little ambiguity in the original description of the preparation. As the patient's death happened so soon after the apparent cure of the aneurism, it is impossible to speak with confidence as to the probability of a recurrence; such recurrence is of course always to be apprehended when a channel remains through the aneurism, and has been noticed after the apparent cure of the disease in many cases of cervical and other aneurisms. But this does

[1] Of which six were for aneurism, supposed to affect the carotid only; in the remainder, the innominate was thought to be the seat of the disease, though it is plain, from the dissection of cases in which death took place, that in some at least the arch of the aorta was diseased.

[2] Mr. Lambert's, quoted from Wardrop, On Aneurism.

[3] The last case operated on in London was under the care of Mr. Lane. The operation was unsuccessful, as the aneurism burst into the lung. — Cooper's Surg. Dict., 8th ed., 1861, vol. i., p. 215.

[1] Fearn, Lancet, 1836–7, vol. i., p. 129; 1837–8, vol. ii., p. 763; and 1838–9, vol. i., p. 437. See also Path. Trans., vol. xviii., p. 42.

Fig. 330.

The parts from the case in which Mr. Fearn, of Derby, tied the carotid and subclavian arteries for innominate aneurism. (From the preparation in the Museum of the Royal College of Surgeons.) *a*. The root of the aorta. *b*. The dilated portion of the arch divided. A portion of the inner wall of the artery is seen above, in a different light, with the left subclavian artery opening out of it. *c*. The aneurism occupying the whole length of the innominate artery, almost entirely filled with firm coagulum, through which, however, a channel is left about equal to that of the natural artery. A portion of clot is seen projecting through the mouth of the aneurism into the aorta. *d*, *e*. The carotid and subclavian arteries at the seat of ligature.

not affect the main fact, which is, that the patient's symptoms were completely relieved; and especially (a point to which I would call particular attention) that the growth of the aneurism against the trachea was stopped. I think we are entitled to reckon Mr. Fearn's case, therefore, as one of cure.

Another and still more interesting case in which temporary cure resulted, was under the care of Mr. Christopher Heath, who tied the third part of the subclavian and the carotid artery simultaneously on November 21, 1865, for an aneurism believed to be innominate.[1] The patient was a woman aged thirty. I have not space to describe the symptoms. It will be sufficient to say that she had had hæmoptysis, was greatly distressed by dyspnœa, and there was also some dysphagia. The diagnosis was a good deal debated at the time. Some surgeons thought the disease a pulsating cancerous tumor of the bones; many (and myself among the number) were rather inclined to believe it to be a tubular aneurism involving the aorta and innominate. Mr. Heath inclined to the belief that the affection was purely innominate. The operation was followed by great and evident relief to the breathing, and the tumor diminished in size, allowing a perforation which existed in the sternum, but had been previously imperceptible, to come into view. The patient survived the operation four years; but the tumor never ceased to pulsate, and she died ultimately of its rupture externally through an aperture in the upper part of the sternum involving the right sterno-clavicular joint.

The parts are in the Museum of the Royal College of Surgeons, and they show a bilocular aneurism of the aorta, the innominate being hardly if at all affected.[1]

In this case the benefit from the operation, and the consequent prolongation of the patient's life, were too decided to admit of any doubt, and I think furnish abundant justification for the treatment employed, in spite of an error in diagnosis, which I believe to have been inevitable. The improvement obtained would no doubt have been more permanent had the patient's habits been different; but she was a woman of most irregular life, and after the operation, had been brought in a state of intoxication into nearly every hospital and workhouse infirmary in her part of London. Here, as in Mr. Fearn's case, the

See Lancet, January 5, 1867

[1] Path. Soc. Trans., vol. xxi.

relief of the dyspnœa is a very striking fact.

The following is a brief abstract of an interesting case, hitherto unpublished, of distal ligature of the subclavian for innominate aneurism. The operation was performed by M. Broca. I am indebted for the case to Mr. Heath, to whom the notes were sent by M. Broca.

The patient was a man aged fifty, who had a pulsating tumor above the right clavicle for about a year. The sterno-clavicular joint on that side was destroyed, so that the clavicle was movable on the sternum. The disease had been diagnosed as an aortic aneurism, and he had been for some time in an asylum for incurables. He was then transferred into a surgical ward by one of the "internes" who wished to study the case, and thus came under M. Broca's observation. He then had a fit, accompanied by convulsions on the left side, difficulty in speech, loss of memory and of general mental power, and violence. This lasted twelve days. When M. Broca examined him he found the pulse absent from the right carotid artery and its branches, and the pulse in the right radial artery, when examined by the sphygmograph, showed considerable modification, while the left radial pulse was almost normal. From these circumstances M. Broca was led to conclude that the aneurism was not of the aorta, but of the innominate, and determined to tie the subclavian beyond the scaleni, judging that the carotid was already closed by impacted clot. At this time there was noisy breathing and much dysphagia, from pressure on the trachea and œsophagus. The operation was performed on August 25 or 26, 1862. On the following day, the patient was able to breathe and swallow readily, the pulsation was already less violent, and what was very curious, the bruit de soufflet, which before the operation was with the first sound of the heart, was now with the second. The ligature came away on the twentieth day, and the wound gradually closed. After his recovery, the tumor still continued to pulsate, and was of about the same size; but it felt much more solid, and the pulsation was neither so powerful nor so superficial. The general health was perfect, and the cerebral symptoms quite disappeared. He went on perfectly well till February, 1863, when he was readmitted with gangrene of the left lung, of which he died. Up to the time of his death, the aneurism remained in the same condition. The pulse had never returned in the carotid and its branches. On post-mortem examination the carotid was found pervious, but reduced in diameter and flattened by pressure. The middle cerebral artery was plugged. The aorta was dilated to one-fourth more than its common calibre. The aneurism occupied the whole length of the innominate artery, "communicating with the aorta by an opening about four centimetres in size" (a little more than an inch in diameter). The tumor enclosed an enormous mass of clot, in the centre of which was a cavity of the size of a small egg. This cavity communicated with the carotid by an oblique and flattened opening, and on the outer side with the subclavian. The latter artery had its normal calibre, but all its branches were much dilated. The bones of the thorax had been extensively eroded, and had at one time evidently been bathed in the blood of the aneurism. This, however, had not prevented the formation of fibrinous clot. Here again I would remark the immediate relief of dyspnœa which followed on the operation.

In order to provide the reader with proper data for forming a judgment on the important question of the advisability of the treatment of cervical aneurism by the distal ligature, I append, in addition to the above cases, the following list of references to the published cases of these operations, for which I am again indebted to Mr. Heath's kindness.

TABLE OF CASES OF DISTAL LIGATURE FOR ANEURISMS AT THE ROOT OF THE NECK.

I. *Aneurism of the Innominate, treated by Ligature of third part of Subclavian.*

1. Wardrop, 1827. Died two years afterwards. Wardrop, On Aneurism.
2. Broca, 1862. Died six months afterwards. Referred to in text.

II. *Aneurism of the Innominate, treated by Ligature of the first part of Axillary.*

Laugier, 1834. Died one month afterwards. Lancet, vol. i., 1834, p. 889.

III. *Aneurism of the Innominate, treated by Ligature of right Common Carotid.*

1. Evans, 1828. Recovered. Wardrop, On Aneurism.
2. Mott, 1829. Died seven months afterwards. Mott's Velpeau.
3. Aston Key, 1830. Died in a few hours. Med. Gaz., vol. vi. Guthrie, On Arteries.
4. Case reported by Neumeister, 1830. Died five days afterwards. Hollond, Dublin Quarterly Journal, February, 1852.
5. Morrison, 1832. Died one year and eight months afterwards. Am. Journ. Med. Sc., xix., p. 329.
6. John Scott. Died. Lancet, 1834–5, i., p. 893.
7. Dohlhoff, 1837. Died sixth day. Broca, On Aneurism, p. 632. Rust. Mag., vol. li., p. 529, 1838.
8. Fergusson, 1841. Died seven days afterwards. Lond. and Edin. Journ., 1841, vol. i., p. 786.
9. Porta, 1842. Died forty hours afterwards. Porta, Alt. patol. delle Art., p. 35.
10. Hutton, 1842. Died sixty-six days afterwards. Dublin Journal, vol. xxv., p. 499.
11. Vilardebo, 1843 (?). Died twenty-one days afterwards. Arch. gén. de Méd., 1847, p. 547.

12. Campbell, 1844. Died nineteenth day. Lond. and Edin. Journ., 1845.
13. Wright, 1855. Died sixty days afterwards. Montreal Med. Chron., April, 1856.
14. Ordile, of Naples. Died.[1]
15. Addinell Hewson, 1867. Died twelve days afterwards. Pennsylvania Hospital Reports, vol. i., 1868.

IV. *Aneurism of the Innominate, treated by double consecutive Distal Ligature.*

1. Fearn. Carotid, August 30, 1836; subclavian, third part, August 2, 1838. Died four months after the last operation. Lancet, 1837, 8, 9.
2. Wickham. Carotid, September 25, 1839; subclavian, third part, December 3, 1839. Died. Lancet, 1839; Med.-Chir. Trans., 1840.
3. Malgaigne. Carotid, March, 1845; axillary, first part, October 17, 1845. Died. Bull. de la Soc. Anat., 1848, vol. xxiii., p. 291.

V. *Aneurism, supposed to be of the Innominate, treated by double simultaneous Distal Ligature.*

1. Rossi, 1843. Carotid and first part of subclavian. Died. Gaz. méd., 1844, p. 58; Broca, On Aneurism.
2. Cuvellier, 1859. Carotid and third part of subclavian. Died. Demme, Spec. Chir. d. Schusswunden, p. 210.
3. Heath, 1865. Carotid and third part of subclavian; survived four years. Lancet, January 5, 1867, referred to in text.
4. Hutchison, of Brooklyn, 1866. Carotid and third part of subclavian (the subclavian is said not to have been really tied; Erichsen, Sci. and Art. of Surgery, vol. ii., p. 59). Recovered from the operation, but died from suffocation on the forty-first day. Brit. Med. Journ., March 30, 1867.

   Maunder, 1867. Carotid and third part of subclavian. Died. Path. Soc. Trans., xix., p. 93.
6. Sands, of New York, 1868. Carotid and third part of subclavian. Recovered from the operation. Disease not cured. Am. Journ. Med. Sci., April, 1869, p. 568.

Mem. In this class, the nature of the cases varied considerably. Rossi's and Hutchison's were really innominate; Cuvellier's was subclavian; Heath's and Maunder's were aortic; Sands's remains uncertain.

VI. *Aneurism of right Carotid, treated by Distal Ligature.*

1. Wardrop, 1825. Recovered. Wardrop, On Aneurism.[2]
2. Lambert, 1826. Died. Wardrop, On Aneurism.
3. Bushe, 1827. Recovered. Wardrop, On Aneurism.
4. Lane, 1852. Died. Art. "Aneurism," Cooper's Surg. Dict., 8th edition, vol. i., p. 215.

VII. *Aneurism of left Carotid, treated by Distal Ligature.*

1. Montgomery, 1829. Died. Guthrie and Broca.
2. Colson (de Noyon), 1840. Recovered. Bull. de l'Acad. de Méd., September, 1841. Robert, sur les Anévr. sus-claviculaires.

VIII. *Aneurism of the Subclavian, treated by Ligature of the Axillary.*

1. Dupuytren, 1829. Died. Lond. Med. Gaz., vol. iv.
2. Canton, 1863. Died. Med. Times and Gaz., January 2, 1864.

IX. *Aneurism of first part of Subclavian, treated by Ligature of third part and Injection.*

Pétrequin, 1853. Died. Broca, p. 419, Gaz. hebd., vol. i., p. 192.

X. *Aneurism of Subclavian, treated by Ligature of Carotid.*

Butcher, 1863. Died fourth day. Butcher, Op. Surg., p. 855.

XI. *Aneurisms in which the Carotid was tied, and which proved to be Aortic.*

1. Tilanus. Lived five months. Velpeau, Méd. Opér.
2. Rigen, 1829. Lived three months. Died of hernia. Velpeau, Méd. Opér.
3. O'Shaughnessy. Died seven days afterwards. Galvano-puncture also. Dub. Med. Press, October 5, 1842.
4. Knowles, 1867. Died of apoplexy. Lancet, June 13, 1868.

[This list has been much enlarged and the record of some of its cases modified by later experience and researches. The reader is referred to Mr. Holmes's Lectures (Lancet, 1872, vol. i., p. 817, and vol. ii., pp. 35, 69, 107, and 287); to an article of my own in the Am. Journal of Med. Sciences, July, 1880, and the note of an autopsy in the same journal for Jan. 7, 1881, p. 192, and to an article by Dr. Wyeth in the last-named number, p. 155. Additional cases to those contained in the above papers are: for Sect. III., one by J. B. Bell, of Augusta, Maine, mentioned by Dr. Speir in the N. Y. Medical Record, 1873, p. 103; Speir's artery constrictor was used, and

[1] This operation was performed about the year 1859, and was communicated to me verbally by the operator.

[2] Wardrop claims to have tied the carotid in a second case of this nature, but as the artery was found completely pervious after death, and with no trace of ligature, it is probable that a mistake was made in the operation. The case is, therefore, not reckoned here.

the patient was doing well a year afterwards. For Sect. V., one by Kelburne King, Brit. Med. Journal, 1880, ii., p. 878; the symptoms were relieved and the patient living at the date of the report, two months after the operation; also one by J. M. Palmer, Brit. Med. Journal, 1880, ii., p. 875, with account of the autopsy one hundred and twenty-five days after the operation. For Sect. VII., a successful case by M. Delens, Bulletins de la Société de Chirurgie, Paris, 1879, p. 828, and 1880, p. 229; and another, also successful, by De Moello Ferrari, J. Soc. d. Sc. med. de Lisbon, 1878, xlii., p. 353 (reference quoted from the Index Medicus).

Cuvellier's case, Sect. V., No. 2, should not be in the list, for the aneurism was of the third part of the subclavian, and the artery was tied in the first part. There is also some doubt as to the part of the subclavian tied in Rossi's case, Sect. V., No. 1. The only account to which I have access, and the one which seems to have been used by previous writers, is a translation of a short note in an Italian journal, not furnished by the operator himself, and giving but scanty and uncertain details. Broca, writing thirteen years afterwards, describes it as ligature of the first part.]

If now it is necessary to express an opinion on a subject which must be allowed to be hardly ripe as yet for a deliberate judgment, I would say that I entertain no doubt of the propriety of performing what I have been in the habit of regarding as peculiarly Wardrop's operation—viz., the distal ligature of the carotid artery in aneurism involving only the root of the carotid. This operation Wardrop himself performed, and induced others to perform, and (in the passage quoted on p. 416) he clearly showed that it could be practised with reasonable prospect of cure in aneurisms where there would be no branch between the tumor and the ligature. Wardrop's name is also associated with the other method of applying the distal ligature, viz., that where one or more branches do intervene between the tumor and the ligature, but in my opinion with less reason. He did indeed suggest the plan, and in one case he performed an operation somewhat on this principle; but it was in itself imperfect; for, though Wardrop saw the necessity of securing both the main trunks in cases of innominate aneurism, in this instance he tied only the subclavian, being deceived by the absence of perceptible pulsation in the carotid into a belief that that artery was occluded. In this case, in Broca's case above quoted, and in Evans's case cited by Wardrop, benefit seems to have resulted from the ligature of one artery only; but it should not be forgotten that in Wardrop's case other treatment was also adopted (copious venesection and antiphlogosis); in Evans's the apparent cure was probably due to impaction of clot; and in Broca's there was amendment, but certainly no cure. In all the other cases in which one artery only has been tied, I cannot see that any good had been done.

There remains the question of double distal ligature. Here, again, I think there is no decisive proof of permanent cure, but Fearn's and Heath's cases were, to say the least of it, highly encouraging; the latter even showing that in aortic aneurism the operation may not be inapplicable—though I would hardly take it on myself to recommend such a proceeding in a case of aneurism known to be aortic.

[Subsequent experience has furnished several cases of relief so great and so prolonged as fully to justify the operation. In one of Mr. Barwell's cases the patient died of pneumonia three months after the operation, and the aneurism was found almost filled with firm clot; in two other cases treated by the same surgeon the symptoms gradually disappeared, and the patients were living in comfort many months afterwards. Dr. Little's patient died of phthisis more than three years after the operation; he had long been free from symptoms of the aneurism, and the sac was found lined with a thick white coagulum. My patient is still living, and now, a year since the operation, does light work and is free from pain except in the clavicle; the aneurism, much reduced in size, still pulsates, but shows no tendency to increase, notwithstanding the patient's dissipated habits. See references in preceding note.]

My opinion on this matter is, in fact, exactly as it is here stated from the report of the debate at the Royal Med. and Chir. Soc., on the reading of Mr. Heath's case there:[1]—"Considering the great difficulty of diagnosis, the risk of finding the arteries diseased where exposed for operation, the great likelihood of serious disease in the aorta or even the heart also, and the possibility of spontaneous cure, or cure by appropriate regimen, it seems prudent not to undertake these operations without the gravest consideration, and in circumstances which can but rarely present themselves. Perhaps the best indication for operation would be the relative amount of pressure on the trachea compared with that of the general symptoms. That is, when the patient is otherwise in moderately good health, but suffers much from dyspnœa, and appears likely to die soon from rupture of the aneurism in this direction, the question of arresting it by ligature of the arteries of the right side might be consid-

[1] Lancet, Jan. 5, 1867.

ered, but in any case it must be regarded rather as palliative than as curative."

[Mr. Holmes's opinion, as expressed in his lectures upon aneurism (Lancet, Aug. 31 and Sept. 7, 1872, pp. 287 and 326), and formed upon the study of a larger number of cases than those known to him at the time he wrote this essay, was more favorable to operative interference, especially with the catgut ligature. He recommends that the carotid alone be tied, and then, if that should prove insufficient, the subclavian in either its first or third portion.]

Old operation for carotid aneurism.—The treatment of aneurism at the root of the neck, at least when it follows a wound, has been lately successfully carried out by Mr. Syme on the old method, by laying open the tumor and searching for both ends of the vessel. An abridged account of this daring operation is appended; the reader, however, can have no idea of the risks and difficulties of such a proceeding without perusing the fuller account in the original, and even then his idea will be but a faint and imperfect one.

The operation performed by Mr. Syme may be thus summarily described.[1] The patient had been stabbed in the root of the neck about two months before, and an aneurism had formed, connected with the lower part of the left common carotid. This had been advancing rapidly, under compression applied to the tumor, so that it was necessary to do something. Mr. Syme made a small opening into the pulsating tumor with a bistoury, and then passed in his finger so as to plug the puncture, and felt about till he got upon the spot where pressure controlled the pulsation, and where, therefore, the opening lay. Keeping this point firmly compressed, he laid the sac freely open, and sponged out the clots. A smooth serous surface was exposed, with no trace of artery or vein. The skin and sternal portion of the sterno-mastoid having now been divided by a transverse incision (pressure being still kept up on the opening with the finger), the edge of the slit in the artery which lay under the finger was caught with catch-forceps, and the vessel drawn towards the trachea; it was then carefully scratched with a knife till the arterial coat was brought into view on the external edge, and a ligature passed round it above the aperture. The same proceeding was repeated below the opening; and now the finger could be withdrawn without the tremendous gush of blood which had before followed its displacement.

It is clear that such an operation as this can be successfully performed (that is to say, performed without instant death resulting) only by a surgeon who possesses a large share of that fertility of resource and dexterity in operating which Mr. Syme showed in so great a degree in this case. On the general question, as to whether a case like the above ought to be treated on Brasdor's plan, or as Mr. Syme treated it, it would be rash to affect to give a positive opinion; much would depend upon the confidence of the surgeon in himself. If he felt able to carry out to a successful conclusion so difficult an operation, he would probably imitate Mr. Syme's practice; if not, he might try the distal ligature of the carotid. Should Brasdor's operation fail to check the progress of the tumor, the old operation might be tried, and even a faint prospect of life might remain to the patient from an attempt made to secure the artery after the aneurism had burst.

The above operation indicates so clearly the steps that should be taken in securing the carotid on account of a wound, that no further description of that proceeding is necessary.

[1] Observations in Clinical Surgery, p. 154.

Aneurisms in the Upper Part of the Neck, the Orbit, and the Cranium.

Aneurisms above the root of the neck will be found to affect either the common carotid just at its bifurcation, or the arteries of the orbit or cranium. The diagnosis in either of the two former situations can generally be established satisfactorily; but few things are so difficult as to distinguish from each other the various diseases which may cause pressure on parts of the brain, or disturbance of the cerebral functions.

The occurrence of dilatation at the upper end of the common carotid artery in a slight degree is natural; and this natural dilatation is comparatively often so far increased that an aneurism results. It is an old observation, that the carotid is the only form of surgical aneurism which is equally frequent in both sexes, if it be not even more common in women. The diagnosis of aneurism situated in any part of the neck, above that portion of the carotid which lies in the immediate vicinity of the subclavian, cannot present any especial difficulty if the sac is formed and the pulsation distinct.[1] The proximity of the tumor to the air-passages and to the nerves which supply the larynx may cause dyspnœa, hoarseness, or even loss of speech, nausea, and perhaps impairment of appetite. There will also be giddiness, and trouble in the head; and perhaps pain, numbness, or other nervous

[1] A case of ruptured artery is mentioned on p. 320, in which much difficulty was at first experienced in forming a diagnosis.

phenomena over the head and face.[1] These symptoms call for decisive and efficient surgical treatment.

Aneurisms situated within the orbit are usually supposed to be of the "anastomotic" variety; but the evidence on this point is far from conclusive. Mr. Busk[2] has shown that many, at any rate, are of the ordinary traumatic variety; and Mr. Nunneley, in his papers on the subject, which give the result of the most extensive experience in this particular which has fallen to any individual, since no less than seven cases have been under his own care, goes so far as to question entirely the correctness of the common opinion, founded on Mr. Travers's case; and believes that all the aneurisms have been of the ordinary spontaneous or traumatic kind, except those which have spread into the orbit from a nævus of the face.[3] Whether all the cases have been so or not, the general correctness of Mr. Nunneley's opinion is not to be impugned, that *most* of these cases (and probably Travers's among them) were common aneurisms.[4] Both the symptoms and the history prove this. Mr. Nunneley's arguments are these: aneurism by anastomosis comes on gradually, generally in early life, as a result of the growth of a congenital nævus; aneurism of the orbit very suddenly, often as the result of a blow, and almost always in advanced life:—aneurism by anastomosis occurs in the subcutaneous tissues; aneurism of the orbit generally in the deepest part of the cavity:—aneurism by anastomosis involves all the neighboring vessels, arteries and veins, in active disease; aneurism of the orbit is generally limited to a single part, or if the neighboring vessels are dilated, they seem only enlarged from obstruction:—ligature of the trunk of a vessel leading to an undoubted aneurism by anastomosis is an extremely unsuccessful operation; in aneurism of the orbit a very successful one: finally, the cases dissected have turned out to be common aneurism.[1]

So far Mr. Nunneley argues, and to my mind very cogently, against the view of the pathology of this disease which ascribes the symptoms to aneurism within the orbit. A further question of much interest is made by Mr. Nunneley's papers[2] as to the position of the disease. The prominence of the eye and the pulsation of the orbit naturally led to the conclusion that the tumor lay in that cavity; but Mr. Bowman's case, referred to below, shows that all the symptoms of "orbital aneurism" may be produced by disease situated in the cavernous sinus, and, in one of Mr. Nunneley's own cases examined after death, nearly four and a half years after ligature of the carotid, there was found a cured circumscribed aneurism of the ophthalmic artery in the sella Turcica (*Med.-Chir Trans.*, xlviii., 29), the vessels in the orbit being of a very small size. Mr. Nunneley believes that in the great majority of cases of protrusion of the globe, the cause is pressure on the venous channels behind the orbit; and this view seems to be the most probable one. It seems that common sacculated aneurism of the ophthalmic artery (or possibly of the end of the internal carotid) follows after an injury, and is accompanied by perceptible aneurismal pulsation and common aneurismal bruit; arterio-venous aneurism may also be thus produced, but will present probably a different kind of pulsation and bruit;[3] but protrusion, bruit, and pulsation may all be produced more gradually by the numerous causes

[1] See the account of Sir A. Cooper's case, Guy's Hospital Reports, vol. i., p. 53.

[2] Med.-Chir. Trans., vol. xxii., p. 133.

[3] Haynes Walton (Surg. Diseases of the Eye, 2d ed., 1861, p. 230) relates a case of congenital tumor protruding the eye, and causing slight pulsation and "an arterial souffle not heard on the other side." Crying greatly increased the protrusion, and the vascularity of the conjunctiva, which was always considerable. It was diagnosed by himself and colleagues to be aneurism by anastomosis. The carotid was tied with perfect success.

[4] This is important, since the success of Travers in tying the carotid has been used, under the assumption that his case was aneurism by anastomosis, to enforce the recommendation of a similar operation in cases of aneurism by anastomosis on the scalp—an operation by which several lives have very probably been sacrificed.

[1] See Mr. Nunneley's account of the dissection of a case under his care which proved fatal, in Path. Soc. Trans., vol. xi., p. 8. I may observe, that the whole of the ophthalmic artery and its branches are represented in the drawing which accompanies Mr. Nunneley's description as dilated, which brings the case somewhat near to cirsoid aneurism. I do not understand how Mr. Nunneley accounts for this dilatation by saying it is the result of obstruction. Such obstruction might act on the artery behind, but surely not in front of the aneurism. Guthrie (Operative Surgery of the eye, p. 168), in referring to the dissection of a case, merely says that he found "true aneurism of the ophthalmic artery of both sides."

[2] Med.-Chir. Trans., vol. xlii., pp. 183, 4; vol. xlviii., p. 15.

[3] A case of arterio-venous aneurism in the cavernous sinus, under M. Nélaton's care, which was diagnosed as an aneurism of the ophthalmic artery, is shortly referred to by Dr. Holmes, in the Am. Journ. of Med. Sc., July, 1864, p. 46. The case is probably reported more at length in some of the French journals.

which may lead to obstruction of, or pressure upon, the great vessels in the cavernous sinus.

The diagnosis of anastomotic aneurism in Travers and Dalrymple's cases rested on the presence of soft compressible thrilling tumors in various parts of the eyelids, which presented a more distinct pulsation when pressure was made on them. It is most probable that these were merely collections of veins enlarged by pressure, and transmitting pulsation from the aneurism lying beneath them.[1]

Aneurism may also affect either the internal carotid artery, in its bony canal or in the cavernous sinus, or one of the arteries of the brain. The symptoms of aneurism affecting the internal carotid in the sinus are mainly of three kinds: (1) the symptoms of aneurism; (2) the symptoms of pressure on the orbital nerves; (3) those of disturbance of the cerebral circulation.

(1) In a well marked case the symptoms of aneurism will come on rapidly, very likely after a blow or other injury; there will be, perhaps, a sharp crack heard, followed by a sawing or rasping noise. This sound will be perceived by the stethoscope applied to the head or neck, more plainly on the affected than the sound side, and will cease at once on making pressure upon the common carotid on the side of the disease. If the disease is limited to the part of the artery contained in the sinus, no tumor will be perceptible externally.[2] (2) The first symptom of pressure upon the orbital nerves is either internal strabismus, from paralysis of the sixth nerve;[3] or ptosis, with external squint and dilated pupil, from pressure on the third nerve;[4] or loss of sensation in the parts supplied by the supra-orbital nerve.[5] Sight on the side of the disease is usually not affected; sometimes, however, objects are seen double, or there is more or less indistinctness of vision, the consequence, probably, of the dilatation of the pupil. These symptoms of pressure on the orbital nerves may exist singly, or in various combinations. (3) The symptoms of cerebral disturbance do not seem greater in a moderately early case of this affection than in an aneurism of the common carotid: headache, giddiness, inability to stoop, frightful dreams, etc. There is no pressure on the brain, since the growth of the tumor is opposed by the dura mater. It seems possible that the aneurism might grow through this membrane, and cause softening of the base of the brain, but I have not met with such a case.

With such a combination of symptoms then, the diagnosis of aneurism may reasonably be made; and the case may justifiably, in the present state of our knowledge, be treated as such.

Such a case was the following, which occurred under the care of Mr. Coe, of Bristol, and Dr. Swayne.[1] The patient was a woman, aged fifty-five. The disease was attributed to a blow five months before, after which she complained of a buzzing and beating noise in the head, which at the time of the account she likened to the puffing of a steam engine, heard more distinctly with the left than the right ear, and accompanied by a continuous sound, like low thunder, emanating from a spot near the posterior superior angle of the right parietal bone. She could not lie down in bed, and was troubled with frightful dreams. There was no bruit in the heart or great vessels, but a most distinct one in the neck and over the whole surface of the head, especially the left petrous bone; pressure on the right carotid had no influence over the sound, but on the left carotid caused it to cease immediately. On auscultating the right carotid carefully, its pulsation could be separated from the bruit, which was also louder on the left side. The left eye squinted a little, and she saw double, one thing by the side of the other. No tumor could be perceived externally. The left carotid was tied on Dec. 11, 1851; the bruit ceased; a gentle continuous murmur followed (ascribed by Mr. Coe to the flow of blood through the tumor from the anastomosing branches); this ceased in about five hours, and all the symptoms subsided. The woman was cured, and, as I was informed by Mr. Coe, remained well about ten years afterwards.

In deciding, however, on the treatment of orbital aneurism, the surgeon should not be in a hurry to recommend any operative measures, unless clearly indicated by the symptoms of the case before him. Mr. Erichsen[2] refers to two cases in which the symptoms of orbital aneurism spontaneously disappeared, and a case which occurred under Mr. Bowman's

[1] See a paper by Mr. Hart, Lancet, March 15, 1862, on a case of arterio-venous aneurism in the orbit cured by ligature of the common carotid artery.

[2] It would seem from Mr. Nunneley's cases that in some of these aneurisms in the sinus, or even more internal, there may be pulsation and fulness in the orbit. I have seen such aneurisms, however, unaccompanied by any orbital symptoms.

[3] Assoc. Journal, 1855, p. 1067.

[4] Path. Soc. Trans., vol. xii., p. 61.

[5] Id. ibid.

[1] Assoc. Journal, 1855, p. 1067.

[2] Science and Art of Surgery, ii., 114. A case is related by Dr. Holmes, Am. Journ. Med. Sc., July, 1864, p. 44, in which the patient recovered under the use of ergot of rye and tincture of veratrum. "Whether the patient's recovery," says Dr. Holmes, "is due to the remedies prescribed, or independent of them, I am unable to say."

care,[1] must be kept in mind, as showing that the diagnosis cannot be regarded as certain.

In that case many of the above symptoms were present—severe pain in the head, after an accident, aggravated by stooping; disturbed sleep; a beating noise in the head, compared to a steam engine; a loud bruit, synchronous with the pulse; troubled vision; protrusion of the globe of the eye, and pulsation in the orbit strong enough visibly to lift the fingers. The carotid artery was tied, and the bruit ceased, but recurred, though not so loud, eight days afterwards. The patient died of secondary hemorrhage, when it was found that the arteries were quite healthy; and the only diseased appearance was in the ophthalmic vein, cavernous, circular, transverse, and superior petrosal sinuses, which were filled with coagula. The pressure on the carotid artery in the sinus must have produced the bruit, the obstruction to the return of blood by the veins of the orbit, the protrusion of the eyeball, and the congestion of the parts around it; while the pulsation perceptible in the orbit is attributed by Mr. Hulke, to whom we are indebted for the report of the case, to the same cause. "Each diastole of the ophthalmic artery," he says, "must have been attended by a general momentary increase of the whole quantity of blood in the orbit, because its exit through the ophthalmic vein was cut off, and the resisting bony walls of the orbit could permit a distension in front only."

The symptoms of aneurism of one of the small arteries at the base or in the substance of the brain, are as yet quite obscure. Physicians and physiologists are busily endeavoring, by experiment and the study of cases, to decide how, from the symptoms of limited pressure or other limited lesion, to determine the precise part of the brain affected. Even if this great difficulty were got over, how are we to decide whether such limited injury depends on pressure by an aneurism, or by a tumor of a different kind, say a scrofulous tubercle?[2] The rapidity of the onset of the symptoms, and the variation in their severity, occasioned by different states of the circulation, seem the only peculiarities which point to aneurism, and they are excessively doubtful and delusive. We have, indeed no means at present of diagnosing cerebral aneurism, unless a bruit could be found; and in looking over a number of cases I do not find any mention of this symptom having been looked for. In Dr. Ogle's case, however, the patient was herself conscious of "a sawing noise" in the head. It seems, therefore, that in similar cases the head should be carefully auscultated, though it is very likely that the small size of the aneurism and of the vessel on which it is seated, and the mass of soft, ill-conducting parts that lie over it, would prevent bruit from being heard.

[Mr. Rivington has collated in a very valuable paper (Med.-Chir. Trans., vol. lviii., 1875, p. 183) 73 cases of intra-orbital aneurism, or, more strictly, of pulsating tumor of the orbit. The paper is too long and (necessarily) too argumentative to be properly summarized within the limits of this essay, and I shall mention, therefore, only those facts which are of chief importance and bear upon points in dispute. Of the 73 cases, 32 were idiopathic and 41 traumatic. Of the former, the right side was affected in 15, the left in 13, both sides in 2, and in 2 the side is not stated. Of the traumatic cases, the right side was affected in 10, the left in 27, both sides in 3, and in one the side is not stated. Consequently, the preponderance formerly noticed of cases upon the left side being shown to exist only in the traumatic group, must be considered accidental. The average age in the idiopathic cases, excluding two for special reasons, was 43 years; 21 of them were in females, and 9 in males; while of the traumatic cases, 31 were in males, and 10 in female

"Symptoms of fracture of the base of the skull were noted in 12 of the traumatic cases; in 17 the severity of the injury to the head renders it most probable that it occurred, whilst in 4 more it might not unfairly be presumed. Of the other cases, 4 followed thrusts in the orbit, 1 was probably an idiopathic affection, 1 was occasioned by a discharge of shot, 1 by the explosion of a soda-water bottle and resulting wound in the upper eyelid, and 1 had several points of resemblance to a case of cancer, although it succeeded an injury." The frequency of this coincidence of fracture of the base of the skull, taken in connection with the lesions found at some of the autopsies, points to rupture of the carotid or ophthalmic artery within the cranium at the time of the accident as the immediate cause of the production of the aneurism, and to the arterio-venous character of the latter. In 2 cases a wound received in the left orbit caused the disease in the right; in one of them the end of an umbrella was thrust through the left eyelid, fractured the sphenoidal bone, and tore the right carotid entirely across in the cavernous sinus; in the other, a discharge of shot received in the left eye was thought to have wounded the right ophthalmic artery.

The 73 cases furnish 12 post mortems, which indicate that the disease has its origin not

[1] Streatfeild's Ophthalmic Reports, April, 1859.

[2] See, in Med.-Chir. Trans., vol. xlii., p. 403, a paper by Dr. Ogle, in which he carefully endeavors to point out how, from the symptoms presented in the case there related, he might have diagnosed lesion limited to the pons Varolii. Even had he done so, however, he would have referred the lesion to pressure by a scrofulous tumor, while it was in reality an aneurism of the anterior cerebellar artery.

within the orbit, but within the cranium in the great majority of cases, and usually in the cavernous sinus. In only 1 of the 12 cases was there found any aneurismal affection within the orbit; in this there was "an ordinary circumscribed aneurism on each ophthalmic artery." In 1 case, diagnosed as inflammatory plugging of the orbital veins, the diagnosis was confirmed at the autopsy two years later. In the remaining 10 cases the symptoms were caused by some disease of the bloodvessels behind the orbit; in 2 of them "obstruction to the passage of blood from the orbit through the intra-cranial sinuses appeared to be the cause of the affection;" in 1 there was a circumscribed aneurism of the ophthalmic artery at its origin; in 3 there was rupture of an aneurismal internal carotid in the cavernous sinus; in 1 simple dilatation and atheroma of the same artery in the same place; and in 3 (traumatic cases) there was direct communication between the carotid artery and cavernous sinus. In no case was aneurism by anastomosis, cirsoid aneurism, or arterio-venous aneurism *within the orbit* found at a post-mortem examination, and the cases diagnosed as such are very doubtful.

In 8 of the 12 cases the ophthalmic vein and its branches were found varicose and enlarged; in 3 the record is incomplete in this respect, and in 1 the typical symptoms appear to have been absent because the hole found in the carotid was plugged by a clot.

The prominence and pulsation of the eyeball, the bruit, and the enlargement of the veins, are easily explained in those cases in which the blood passed directly from the carotid into the cavernous sinus, but the explanation is not so easy in those other cases in which the primary lesion apparently was simple obstruction of the venous current. The reader is referred to Mr. Rivington's paper for the discussion of the different theories offered in explanation. Mr. Rivington believes that the pulsation is either communicated from the carotid to the blood which surrounds it in the sinus, and thence to that in the ophthalmic vein, or is the direct continuation of the arterial impulse through the dilated capillaries.

To these autopsies may be added two others reported since the date of Mr. Rivington's paper. Mr. Hutchinson reported to the Clinical Society (British Medical Journal, April 17, 1875) a case in which he had proposed to tie the carotid artery for this disease; the patient asked for a postponement, the symptoms subsided and ultimately disappeared spontaneously. Ten years later the patient died, and there was found a sacculated aneurism of the internal carotid occupying the left middle fossa of the cranium and filled with laminated clot. The other case is reported by Dr. T. G. Morton in the Am. Journ. of Med. Sciences, April, 1876, p. 339. The disease began suddenly in a girl of twenty-three years with sharp pain in the left temple, so sharp and sudden that she thought it was the sting of a bee. The same evening she noticed a whizzing noise in the head and exophthalmos. In forty-eight hours vision was entirely lost in the left eye. On examination five days afterwards, there was extreme exophthalmos, pupil dilated, congestion of the globe, paralysis of the muscles supplied by the third, fourth, and sixth nerves, and partial paralysis of the ophthalmic branch of the fifth, great œdema of the upper eyelid, dull, heavy pain, blindness, and an intermittent bruit synchronous with the cardiac systole and arrested by pressure on the left carotid. On the eleventh day the cornea sloughed; on the nineteenth the carotid was tied. The following day the patient had an attack of nausea and abdominal pain similar to one on the day preceding the operation, grew very pale, and died. The autopsy was incomplete; it showed no trace of any aneurismal disease, and only extensive phlebitis and complete plugging of the ophthalmic, circular, and cavernous sinuses on the left side, and firm matting together by recent lymph of the nerves and bloodvessels at the entrance of the left orbital cavity.

In the same connection may be mentioned the sequel of another of Dr. Morton's cases which is given in part by Mr. Rivington (traumatic cases, No. 35). Dr. Morton considers it an aneurism by anastomosis, and if his view is correct, the case is, with possibly one exception (Mr. Haynes Walton's case), the only one on record of this affection in the orbit. It was a soft, compressible tumor above the eye and extending backwards, the result of a blow. Exophthalmos was strongly marked; there was a feeble bruit and a slight pulsation, controlled by pressure on the carotid. This was the condition in March, 1870, shortly before Dr. Morton first reported the case (Am. Journ. Med. Sciences, July, 1870), and expressed the opinion that "a partial removal of the tumor with the knife and ligation of its deeper portion would probably be sufficient." A little more than a year afterwards he was again called to see the patient, who had just received another blow on the eye. He says (Am. Journal Med. Sci., April, 1876, p. 344): "His previous condition was aggravated by this injury, which caused a rupture of small vessels, with effusion into the orbit, leading to excessive exophthalmos, and intense pain from the distension; an abscess was developing in the outer chamber of the eye, and the organ was stone-blind. There was pulsation, bruit, and a whirr. I then made an incision across the brow, commencing at the outer canthus and extending rather beyond the mesial line; the flap thus made was turned down, the tumor was reached, and the entire contents of the orbital cavity were then rapidly enucleated. In completing the excision, the bleeding became excessive, but was controlled by the actual cautery and pressure. The removal of the entire contents of the orbit in this case verified the correctness of the original diagnosis of 'aneurism by anastomosis,' for the tumor was found to be composed mainly of enlarged bloodvessels, with connective and fibrous tissue. The patient completely recovered; the orbit subsequently became filled by gran-

ulations and healed perfectly." The microscopical report is: "the tumor of the orbit is composed of loose connective and adipose tissue abounding in bloodvessels. It also contains some small masses consisting chiefly of fibrous tissue in bundles varying from $\frac{1}{800}$th to $\frac{1}{1000}$th of an inch in diameter, crossing each other in every direction."

According to Mr. Rivington (loc. cit., p. 213), "the *typical symptoms* of the so-called 'intra-orbital aneurism' are exophthalmos, a chemosed pad of conjunctiva concealing the lower lid, pain, paralysis of orbital muscles and iris, with or without anæsthesia, pulsation of the eyeball, a pulsating tumor above the eye beneath the inner part of the orbital arch, distension of conjunctival vessels, obliteration of the hollow beneath the orbital arch, bruit, and noises in the head. Pulsation of the eyeball, a pulsating tumor, and paralysis of the ocular muscles may be absent without contraindicating the diagnosis of aneurism; but I do not think that any case should be regarded as aneurismal in which a bruit cannot be heard, or be placed under the head of 'Intra-orbital Aneurism,' unless, in the absence of pulsation, exophthalmos and congestion of conjunctiva accompany the bruit."

In the majority of Mr. Rivington's idiopathic cases the first symptom was the sudden occurrence of pain or noise in the head, or some peculiar feeling on the affected side; in 5 cases the disease began during pregnancy, with violent pain or noise in the head; in 2 the patients were roused from sleep by the pain and noise; one woman, during an effort of childbirth, felt "an unusual rattling in the eye," and noticed that "the eye was driven from the orbit;" and a man, after a fit of coughing and without any previous symptoms, noticed that the eye was projecting from the socket. Exophthalmos and swelling of the lids and conjunctiva are usually the next symptoms. In the traumatic cases the aneurismal symptoms are usually masked at first by the symptoms of the injury to the head; as a rule, they are fully developed within nine months after the injury, and in more than half the cases within two months. In only two cases was there an interval of years.

Mr. Rivington's conclusions as to the comparative value of the different methods of treatment are as follows:—

Medical remedies, such as belladonna, digitalis, and veratrum, are worthy of trial in the first instance, or as adjuncts to digital compression, rest, and cold, for one idiopathic and four traumatic cases have been cured by simple measures.

Digital compression has been tried in 16 cases, of which 5, perhaps 6, were idiopathic and 10 traumatic; 2 of the first and the doubtful case were cured; in the others no benefit was obtained. It may, therefore, be considered as likely to succeed in idiopathic cases dependent on true aneurism, and very unlikely to succeed in cases of free arterio-venous communication. It is to be preferred to instrumental compression.

Galvano-puncture has been tried twice, each time in a traumatic case, and unsuccessfully, one of the patients dying apparently in consequence of the operation.

The injection of coagulating liquids is suitable only in cases of arterio-venous communication, and can be used most conveniently when the pulsating veins are prominent at and beyond the margin of the orbit. It is more painful and probably involves more risk to vision than ligature. The perchloride of iron has been used successfully in two cases, and unsuccessfully in one; the failure was thought to be due to the smallness of the quantity used. The lactate of iron cured one case after failure of ligature of the carotid.

The subcutaneous injection of ergotine, practised in one case, was followed by nausea, œdema, and increase of the tumor.

"Ligature of the common carotid is, beyond question, the means most generally applicable to cases of intra-orbital aneurism dependent on morbid states of the arteries." Forty-four cases with 46 operations, 2 being double, give 6 deaths; rejecting 2 of these as an improper use of the method, because the patients were over 60 years of age, and 2 in which the cause of death seems to have been independent of the operation, Mr. Rivington estimates the mortality as 2 in 40, or 5 per cent. Of 18 idiopathic cases thus treated, 15 recovered and 3 died; of the 15, 12 were cured and 3 partly benefited. Of 26 traumatic cases, 23 recovered and 3 died; of the 23, 14 were cured, in 8 of these the cure being "in all respects complete;" in 5 the operation was unsuccessful; 2 of them were subsequently cured by ligature of the other carotid, and 1 by injection of the lactate of iron. In 4 partial benefit resulted, the symptoms being diminished in 3 and temporarily removed in the other.

It thus appears that the percentage of partial or complete failures after ligature of the carotid is not small, and, moreover, it is not unlikely that in some of the cases reported cured the disease may have returned; therefore, a hurried resort to ligature is not to be advised; but, Mr. Rivington says, "on the whole, I am strongly disposed to agree with Mr. Curling and Dr. Morton, that in traumatic cases and in suitable subjects ligature should be practised early when vision is threatened."

Mr. Holmes, on the other hand (Lancet, 1873, ii., p. 257), says that he "looks forward to the more careful and persevering use of digital compression of the carotid artery as a means of avoiding the danger to life which the ligature of the carotid involves." "In the graver and more obstinate cases of this affection I would not refuse to give the patient the chance of relief from the ligature of the carotid artery. But to apply this measure indiscriminately to all cases, in the way Mr. Nunneley recommends, is not compatible with what we now know about the pathology or surgery of intra-orbital aneurism."]

Treatment of these aneurisms.—Aneurisms situated in the carotid triangle of the neck must be treated on ordinary

principles, digital pressure on the trunk of the vessel being used in cases where the symptoms are not very urgent, combined, perhaps, with moderate pressure over the tumor (*vide* p. 364); in severer cases, or on the failure of these measures, the common carotid artery must be tied. Besides the ordinary medical and dietetic means, and excluding a very few cases in which the surgeon might be tempted to try the effect of galvano-puncture, there are only two methods of treatment available for aneurism within the cranium or orbit, *i. e.*, pressure on, or ligature of, the carotid artery. The use of digital pressure has been successful in supposed aneurism of the orbit, under the care of Gioppi and Vanzetti (p. 367); and there can be no reason why it should not succeed in such a case as Mr. Coe's. It need not give much annoyance to the patient, and can be carried on as long as the disease is either receding, or even not advancing. When its failure is certain, the common carotid artery should be secured.[1] It would at first sight appear better, as the disease is seated upon the internal carotid, to secure that vessel; but it does not seem that any advantage is obtained by leaving the stream of blood in the external carotid unobstructed. In orbital aneurism, the free anastomosis might reproduce the disease; in aneurism at the base of the brain, the danger of softening of the brain is as great after ligature of the internal as of the common carotid; while no harm ever comes from stopping the circulation through the branches of the external carotid. So that, as the ligature of the common carotid artery is an easier and safer proceeding, it is rightly performed. Dr. Morton[2] gives a list of thirty cases in which the carotid has been tied for "orbital aneurism;" twenty-two of which succeeded completely and three incompletely in arresting the symptoms; two were unsuccessful, but the patient survived; three died. Injection was used successfully in two cases, and digital pressure in two.

The ligature of the common carotid in an ordinary case of aneurism, where the patient is not very stout, the aneurism not situated near the root of the neck, but towards the angle of the jaw,[3] and the parts healthy, is generally an easy operation. The artery can be felt, in any person not extremely stout, pulsating on the anterior edge of the sterno-mastoid muscle, at the level of the cricoid cartilage, where it first becomes superficial, after having been crossed by the omohyoid muscle—the apex of the carotid triangle. This is accordingly the place of selection for the ligature. [See Fig. 329, *e*.] The operation is thus performed: If the sterno-mastoid muscle is perceptible, an incision about two and a half inches in length (in a moderately stout adult) is to be made along its anterior edge, the centre corresponding to the level of the cricoid cartilage; and after the cervical fascia has been divided, which may be done freely, as no important parts are endangered, the edge of the sterno-mastoid ought to be exposed. This having been drawn a little outwards, the finger should be passed into the wound, to feel for the trachea, when the artery will be felt lying between the muscle and the air-tube. The operator must now carefully separate the cellular tissue from the sheath which covers the artery, and endeavor to raise the descending branch of the ninth nerve, which generally lies upon the sheath. This nerve, when exposed, is to be held aside with a blunt hook, while a small opening is made in the sheath of the artery; and the vessel having been cleaned by the usual manipulations, the ligature is to be passed around it from without inwards, great care being taken to keep the point of the aneurism-needle quite close to the artery, so as to avoid wounding or tying the pneumo-gastric nerve. The operator must remember that the descendens noni nerve sometimes lies within instead of upon, the sheath of the vessels; so that, when it has not been met with after a sufficient search, the artery may be tied without seeing it; but in this case even more than common care should be bestowed in examining the vessel as it lies upon the aneurism-needle in order to make sure that this nerve has not been included. In the course of the dissection some bleeding may occur from the sterno-mastoid artery, which is usually the descending branch of the superior thyroid, and may prove annoying to the operator unless the vessel be tied.

When the aneurism is situated lower in

[1] In Mr. Hart's paper he attributes to the previous use of digital pressure, and consequent dilatation of the collateral arteries, the entire immunity from all symptoms which his patient displayed after ligature of the carotid artery; an immunity which was certainly remarkable.

[2] Am. Journ. Med. Sc., April, 1865, p. 318.

[3] This observation of course applies still more forcibly to the cases in which the disease is situated in the orbit, and therefore quite away from the parts operated on; but in a case where Brasdor's method was applied for a tumor at the root of the neck, and in a case of Hunterian ligature, where the tumor was lower down than usual, I remember seeing considerable difficulty experienced by the operators from the circumstance that the artery had been displaced backwards by the pressure of the tumor.

the neck, the operation becomes more difficult, since it is necessary to cut through a considerable mass of muscle. The artery is here situated under cover of the sterno-mastoid, with the sterno-hyoid and sterno-thyroid muscles. An incision must be made along the course of the artery, viz., the line joining the sterno-clavicular articulation with the point midway between the angle of the jaw and the mastoid process, and this incision may be joined by another running outwards. The inner, or sternal, portion of the sterno-mastoid is to be cut across, and this being drawn outwards with a broad retractor, it will be generally possible to draw the two other muscles inwards, otherwise they must be divided. The sheath of the vessels will now be exposed; but there will in all probability be several large veins lying over it, which descend from the thyroid body, and on the left side of the neck the internal jugular itself inclines considerably to the front of the artery towards the thorax. The wound also is very deep, and the vessel is probably rendered relatively deeper by the projection of the tumor. Still, by keeping the course of the vessel steadily in view, and by feeling for the trachea internally and the transverse processes of the vertebræ behind, the artery must be reached. Great care, however, is necessary in opening the sheath and cleaning the artery, since the vessel itself can hardly be brought fairly in view. The proximity of the stream of blood in the innominate artery on the right side is a great, but not a fatal, objection to this operation. Porter[1] tied the right carotid successfully within half an inch of the bifurcation of the innominate.

The operation of tying the common carotid artery used to be looked upon as one of the most successful in surgery; and perhaps, if we regard the important parts whose circulation is interfered with, that opinion may seem relatively justified; but absolutely the mortality is now known to be very considerable.

In the paper on the subject by Dr. Norris above referred to, the result of 149 cases in which the carotid was tied, has been tabulated. Of these, 54 died, or more than one-third; an amount of mortality much exceeding that of any of the commoner operations of surgery. Dr. Norris's paper, however, includes all classes of cases, tabulated as: I. Operations for aneurisms (Hunterian); II. For wounds; III. In or previous to extirpation of tumors; IV. For cerebral affections; V. For erectile tumors of the orbit, scalp, etc.; VI. On Brasdor's method for aneurisms. We may consider separately the cases in which the artery is tied for the cure of a disease, by excluding classes II. and III.; and then Dr. Norris's table (rejecting one case, in which it is doubtful whether the artery was really tied) gives us exactly 100 cases, with a mortality of 33. It seems, therefore, fair to say, that the ordinary ligature of the common carotid for diseases involves a risk which may be represented on an average by a mortality of one-third. Possibly, where the disease is remote, the chance of recovery is greater. In Dr. Morton's paper, above referred to, out of thirty cases where the carotid was tied for aneurism in the orbit, only three died.

Dr. Pilz's statistics[1] give exactly 600 cases, thus divided:—

	Cases.	Cured.	Died.	Unaccounted for.
For bleeding	228	94	128	6
For aneurism	87	55	31	1
For tumors	142	87	49	6
For extirpations	71	38	25	8
For affections of nervous system	34	33	1	—
For aneurism, on Brasdor's method	38	12	25	1
	600	319	259	22
Deaths	43.16 per cent.			

Dr. Pilz deducts from the mortality 29 cases where death was due to other causes, *e. g.*, where the carotid has been tied for hemorrhage really due to wound of the vertebral artery, and which proved fatal. The general inference as to the mortality due to the operation is the same as from Norris's paper. The extraordinary success of the operation when performed for "affections of the nervous system" (*i. e.*, for epilepsy, headache, and neuralgia), shows that in this, as in other ligatures of arteries, it is not so much the intrinsic danger of the operation which leads to its great mortality, as its performance upon patients already seriously diseased or injured —though this does not, of course, excuse the performance of the operation in such cases.

M. Le Fort's paper on the therapeutical value of the ligature of the common carotid artery, in the Gaz. hebd., 1868, Nos. 28, 30, 35, does not contain so large a number of cases as those of Dr. Pilz, his total being 435, nor is it accompanied by the references. It is very possible, however, that it may be free from the errors which (as M. Le Fort hints) somewhat detract from the value of the German author's elaborate paper. M. Le Fort's essay is well worthy of perusal; and I cannot forbear to quote its conclusion, as being, I think, justified by our experience of this operation: "The ligature of the external carotid ought to be substituted for that of the common carotid whenever it is possible; and if the latter operation is a rare one, it ought to be still rarer; not only from its danger, but also because it is inefficacious in many more instances than would be thought, if judged merely by some fortunate cases which are known and quoted by all the world."

Both carotids have been tied in a great

[1] Sup. cit.

[1] Langenbeck's Archiv, vol. ix., 1868, p. 394.

number of cases. In one case only[1] the double ligature was simultaneous; the patient died in twenty-four hours, of coma. The simultaneous ligature should never be performed unless the chance should be afforded of thus treating a case of wound, which, however, is very improbable. But there are many cases of successful ligature of both carotids, with an interval of time between the two operations. Tables of these cases will be found in Dr. Pilz's work above referred to (p. 415), and in Mr. Erichsen's (vol. ii., p. 67). The general result seems to be, that (excluding Mott's fatal case of simultaneous ligature) there have been 26 or 28 cases, of which at least 18 (possibly 20) recovered. Some of the patients who recovered had severe cerebral symptoms, and one lost an eye from disorganizing inflammation; but the above list shows clearly the possibility and even probability of recovery from so formidable an operative procedure. But the propriety of undertaking such treatment may well be questioned. In many of the cases the operations were performed for the cure of epilepsy—a proceeding which I believe nobody would now countenance. Nor in aneurism by anastomosis can I believe that there is enough prospect of cure to justify so dangerous a measure. A few of the operations were done for hemorrhage—and of course any measure which is necessary to check hemorrhage is justifiable—but we can hardly believe that such cases will often occur. On the whole I think ligature of both carotids can hardly ever be advisable, and very rarely justifiable.

The chief causes of death after ligature of any large artery, excluding those affections which depend on previous disease and the complications which follow on any grave surgical operation, are secondary hemorrhage and gangrene. The former is comparatively rare after ligature of the carotid, in consequence of its long course without branches. Still it is not perhaps so uncommon as is generally supposed, since among the fifty-four fatal cases in Dr. Norris's table, hemorrhage is noted as the cause of death in fifteen of them, and it may have been present as a symptom in many of those which recovered.

Gangrene shows itself principally in the form of softening of the brain. The external parts of the head and neck are never, as it seems, affected with gangrene, a fact which is readily accounted for by the free anastomoses and liberal supply of the vessels of the face and neck. The anastomoses in the brain are indeed even more abundant; but then the brain appears to be more in want of a constant and equable supply, and to tolerate badly the withdrawal for even a short space of so large a quantity of blood as is brought to it by this great artery. Twelve of the fifty-four cases in Dr. Norris's table seem to have proved fatal from some symptoms referable to the brain, which, however, are very variously stated; "convulsions," "apoplexy," and "inflammation" of the brain, being the more common headings. It may be allowed us to doubt, in the absence of more exact information, whether this "inflammation" was not, in most cases at any rate, atrophic softening.[1]

Either the external or internal carotid may be tied for a wound of the vessel itself in the carotid triangle. The operation does not essentially differ from that on the common carotid. An incision made in the same line but higher up will lead down directly upon the internal carotid. But the circumstances which would justify ligature of either of the secondary carotid arteries, except for wound, must be very rare. In aneurism affecting the internal carotid in the cranium, I have already stated the reasons which would lead me to prefer the ligature of the common carotid. I have not met with any account of cases of true aneurism of the branches of the external carotid, except traumatic aneurisms of the temporal artery, which are usually under the control of direct and indirect pressure, otherwise the temporal artery itself may be easily tied either by the Hunterian or the old method. But cirsoid or anastomotic aneurisms of the branches of the external carotid are not so uncommon, and, upon the failure of other methods, it might be thought advisable to tie the external carotid artery. If so, it would be perhaps better to secure the arteries on both sides at the same operation, as was done successfully by M. Maisonneuve in four cases. In wounds of arteries derived from the common carotid, occurring in inaccessible situations, the common carotid artery itself has usually been tied, and with frequent success. This operation has called down the vehement censure of Mr. Guthrie in cases of wound of the internal carotid from the fauces; but the operation by which he proposed[2] to secure the two ends of the bleeding internal carotid, after having divided and turned up the ramus of the lower jaw, has not yet been demonstrated to be practicable on the living body, and it seems hardly worth while to describe an operation which will probably never be put in practice.[3]

We may, however, allow that every

[1] V. Mott, Amer. Med. Journal, July, 1847; Prov. Med. and Surg. Journal, 1848, p. 137.

[1] See the observations on this head in Dr. Pilz's paper above referred to, p. 408 et seq.

[2] Commentaries, p. 256.

[3] The usual practice of securing the common carotid is recommended in the essay on Injuries of Vessels, vol. i., p. 460.

exertion should be made to secure the bleeding artery itself in any case, and that it is only where that operation is plainly impossible, that it is justifiable to resort to so uncertain a measure as tying the trunk-vessel.

In order to find the external carotid, M. Guyon, who has written a special memoir on the subject,[1] gives the following directions. Make an incision downwards from a little external to the angle of the jaw to near the anterior edge of the sterno-mastoid, from one-third to half an inch below the upper border of the thyroid cartilage; dissect away some cervical glands and the venous branches, connected chiefly with the facial and lingual veins, which lie over the artery. The glands should not be torn away or lifted, for fear of tearing the veins to which they adhere closely, but freely incised, and the veins tied and divided if necessary. Then look for the hypoglossal nerve, which crosses the artery perpendicularly, and will serve as a guide to the vessel lying immediately beneath. There is usually about half an inch of the trunk available for the purpose of placing the ligature, between the origin of the superior thyroid, which is generally close to the bifurcation, and that of the lingual, facial, and occipital above. The identity of the vessel may be known by its relation to the hypoglossal nerve, the presence of a collateral (the superior thyroid) when it happens to come into view, and the fact that pressure on the exposed vessel commands the pulse in the temporal. In twenty-three of the cases mentioned in M. Guyon's paper where this vessel was tied, none died from the operation, and none had secondary hemorrhage. In four of these both external carotid arteries were tied, so that the number of patients was only nineteen. The twenty-fourth case quoted by M. Guyon, was one in M. Maisonneuve's practice, where secondary hemorrhage took place after the separation of the ligature: the common and internal carotid were tied, and the sympathetic nerve was injured. The patient died.

[Dr. Langdon R. Longworth (Archives of Scientific and Practical Medicine, N. Y., No. 5, 1873) collected 32 cases of ligature of the external carotid, with only 1 death. The paper may be consulted with profit for the details of the cases and of the anatomy of the artery.]

Any of the branches of the external carotid which arise in the carotid triangle may require to be tied on account of a wound; but no special directions appear necessary. The diagnosis of the particular vessel injured would be impossible till the parts had been exposed, when the bleeding would be the only sure guide to the mouth of the artery. But the lingual artery may require ligature on account of disease or injury. The operation has now been frequently performed, either to check the growth of cancerous tumors or to arrest hemorrhage from such tumors, or even from a wound. In either case it might be necessary to secure the artery on both sides.[1]

The operation is thus performed: The patient being in the recumbent position, with the head drawn over to the sound side, and a small pillow under the neck, an incision is made obliquely downwards and backwards, about two and a half inches in length, its centre being opposite the end of the great cornu of the hyoid bone. The superficial parts being divided, the point above mentioned should be kept in view, and the lingual [hypoglossal] nerve exposed. The artery runs deeper than the nerve to gain the deep surface of the hyoglossus muscle, and must be carefully searched for in the cellular tissue. This operation is more difficult than the description would seem to imply. The reason is, that as the parts are unsupported except by the loose and soft wall of the pharynx, the vessel is constantly retreating from the operator, who must be careful in conducting his dissection, for fear of wounding the pharynx. As the vessel is tortuous, it is necessary to keep close upon the end of the great cornu of the hyoid bone—the only sure guide to it. In the dissection, a large vein, the internal jugular or one of its branches, may be exposed.

The French method, which M. Demarquay seems to have adopted, is to make an incision more or less horizontal through the fibres of the hyoglossus muscle at the apex of the digastric triangle, below the level of the ninth nerve, and parallel to the hyoid bone. This is believed to be more certain than the other method, since the artery sometimes comes off from the carotid along with the facial, and in such cases passes downwards to gain the cover of the hyoglossus. Mr. Heath informs me that he tied the lingual artery in this manner for hemorrhage in cancer of the tongue on January 1, 1869, and found no difficulty, though the operation was performed at night. On the division of the muscle, the artery at once presented itself.

[1] Mém. de la Soc. de chir. de Paris, tome vi., 1863.

[1] See Moore, Med.-Chir. Trans., vol. xlv., p. 56. The most complete memoir on the subject of ligature of the arteries of the tongue with which I am acquainted is by M. Demarquay, Gaz. méd. de Paris, 1867, p. 634.

In the first edition of this work, the ligature of the smaller arteries of the neck was passed over without special mention, nor indeed is the subject of any practical importance; but as the superior and inferior thyroid arteries have been tied in bronchocele, though the operation is not one which can be recommended, it may be as well to describe the method by which they may be secured.[1] For the superior thyroid an incision is to be made two inches long, parallel to the inner margin of the sterno-mastoid, its centre corresponding to the great cornu of the thyroid cartilage. This brings into view the omohyoid muscle, and the sheath inclosing the jugular vein and common carotid; the fibrous lamellæ which cover the artery having been torn apart with a director, the superior thyroid may be found running downwards between the vessels and the thyroid gland; or if the facial is the artery sought for, it can be found by the same incision, the search being conducted upwards towards the jaw, where the artery is found between the great vessels and the submaxillary gland.

The inferior thyroid is to be sought by an incision similar to that for the carotid in the lower part of the neck. It is usually concealed by the upper part of the omohyoid muscle. This muscle must therefore be depressed or divided, and the artery sought for between the trachea or œsophagus and the trunk of the carotid. The recurrent nerve and the descendens noni will be endangered in this operation.

REGIONAL SURGERY OF ANEURISMS IN THE ABDOMEN AND LOWER EXTREMITY.

The Foot and Leg.

As in the upper extremity, so still more in the lower, aneurism hardly ever affects the arteries below the great hinge-joint, except as the result of accident. Spontaneous aneurism, it is true, is not unknown in the leg; but it is extremely rare. The museum of St. George's Hospital contains a specimen of aneurism of the posterior tibial artery cured by ligature of the femoral; and other scattered examples of these aneurisms may be found in pathological collections. These aneurisms, like those in the forearm, will hardly ever be found originating spontaneously except in subjects affected with extensive disease of the heart and arteries; and appropriate position, bandaging, and digital pressure on the first accessible artery above the tumor, will be the appropriate means of cure for these, as for those. If this treatment should fail, it will be for the surgeon to consider whether his patient has sufficient vital power to survive the ligature of the femoral artery, and whether the disease is grave enough to justify the risks by which that operation must be attended.

Pressure and proper position will, in all probability, stop bleeding from any vessel in the foot; but it is possible that a traumatic aneurism in the foot or near the ankle may necessitate the ligature of one or other of the tibial arteries; these vessels, however, are much more often tied on account of wound.

The *ligature of the anterior tibial* may be thus performed. If the vessel requires to be tied above the middle of the leg, it will be found very deeply placed on the interosseous membrane, between the thick muscular bellies of the tibialis anticus on the one side, and on the other, of the extensor longus digitorum above, and extensor proprius pollicis below, tightly bound down by the fascia of the leg. In order to reach it on the living subject with any tolerable facility and in any tolerable time, the intermuscular space must be hit, and the vessels exposed without any groping about among the muscles. This can be easily done on the dead subject, but on the living the operation must be one of considerable difficulty. An incision, proportioned to the fatness of the leg (about four inches might be taken as a moderate length), is to be made in the line joining the head of the fibula with the middle point between the two malleoli. The skin and superficial fascia being separated from the deep fascia, a whiter line running down the latter will be seen marking the inter-muscular space.[1] This is to be slit up to the same extent as the original wound, and the muscles drawn forcibly apart with broad retractors, the ankle being flexed in order to relax them. Then, at the bottom of the deep interval, the nerve will come into view, and below it the vessels will be found inclining to its inner side. Even in the dead subject there is often considerable difficulty in getting a ligature round the anterior tibial (especially if the operator wishes not to include the veins, which, however, in the living body would be almost a matter of indifference); and this difficulty would be much increased in practice by the fact that the operation would probably be undertaken on account of a wound, and that the neighboring parts would be obscured by the extravasated blood, the muscles perhaps lacerated, and the cavity in which the vessel lies so deep that the

[1] See Mott's Velpeau, vol. ii., p. 227.

[1] Guthrie recommends that the foot be alternately flexed and extended to bring these muscles into view more distinctly.

bleeding, by which alone the artery could be recognized, would also constantly obscure and hide the bleeding orifice. Hence in such cases great pains should be taken to endeavor to restrain the bleeding by graduated compresses, or by digital pressure in the wound, before resorting to an operation which may fail, and if it does so, may cost the patient his limb.[1]

In the lower part of the leg, where the muscles have ended in their tendons, and where the vessels are supported on the tibia, there will be much less difficulty in finding the artery; but the line of incision is the same, and the same muscle (tibialis anticus) serves as a guide, the artery lying on its outer side.

The remarks above made, as to the propriety of endeavoring, if possible, to avoid operating on small arteries so deeply seated as those of the upper part of the leg, apply to the posterior tibial, and still more forcibly to the peroneal, which, however, has been successfully tied on account of wound by Mr. Guthrie;[2] but no special instructions are needed for this operation, which consisted merely of making a very long incision in the middle line of the calf (seven inches in length, with its centre at the wound), dissecting down towards the fibula, turning out the clots, and looking for the bleeding point; in doing which it was necessary to cross the incision by one running towards the fibula, so as to turn down two little flaps. The bleeding point having been seen, a sharp hook was struck into the tissues below it, and the whole was tied up in two ligatures above and below the part whence the bleeding proceeded. As the patient recovered, it was, of course, impossible to affirm that the peroneal was really the artery which had been tied.

Ligature of the posterior tibial in the upper part of its course, where it lies under the deep fascia which separates the mass of muscles forming the superficial layer of the calf from those which form the deeper layer, can be effected in one of two ways. The first of these consists in making an incision of suitable length (say six inches) along the posterior edge of the tibia, and having divided the fascia, pulling the gastrocnemius away, cutting the soleus off the tibia to the extent to which it is exposed, and thus coming down upon the deep fascia, which covers the artery, and which is to be divided with the usual precautions, in order to search for the vessel lying below it. This way of making the incision, which is the old method of reaching the vessel, is condemned by Mr. Guthrie as "difficult, tedious, bloody, and dangerous;" and he proposes to substitute for it a vertical incision along the middle line of the calf, over the position of the vessel, through the gastrocnemius and soleus muscles. Mr. Guthrie himself never had the opportunity of carrying out this suggestion; but it was put in practice by Mr. Arnott in a case where he tied the artery for a wound.[1]

In that case, indeed, the position and direction of the external wound would have indicated some such course; but Mr. Arnott has put on record his preference for Mr. Guthrie's method, and advises that it should be followed if it should ever become necessary to tie the posterior tibial on account of aneurism situated low in the leg; a necessity which does not seem hitherto to have occurred. Mr. Arnott, however, remarks about his operation what is probably even more applicable to the old procedure. "It is not one which should be undertaken inconsiderately. It requires good light, and intelligent assistants. The case which has been described occurred in the daytime; and from what was then experienced, I am disposed to think that it would not have been successfully performed by artificial light, or at least with greatly increased difficulty."[2] The difficulties which Mr. Arnott experienced were dependent, he says, on the depth of the wound, the pain and cramp on pressure of the divided muscles, and the venous hemorrhage from concomitant wound of the venæ comites. Of these difficulties, Mr. Arnott rates the first as the least, and the last the greatest. The second would, of course, in the present day be avoided entirely by anæsthesia; but the third must always be anticipated in operations for wound of the artery, since the venæ comites are closely connected to it. [The third difficulty can be removed by the use of Esmarch's bandage, but this measure would at the same time deprive the surgeon of the aid furnished at need by the jet from the divided artery.] Pressure in the angle of the wound from which the bleeding comes must be maintained as much as possible during the operation by the finger of an assistant. The trunk of the femoral or popliteal is of course secured by a tourniquet. An incision is to be made six or seven inches in length, down the middle of the calf of the leg, including the skin-

[1] I am informed by Mr. Moore that in a case where he had occasion to tie the anterior tibial for a wound, he found much assistance to discovering the position of the vessel from tracing back its branches, which are given off in considerable numbers to the muscles around it.

[2] On Wounds and Injuries of Arteries, p. 35, 1846.

[1] Med.-Chir. Trans., vol. xxix.

[2] Op. cit., p. 51.

wound in its centre. The gastrocnemius and soleus muscles are to be freely divided in the course of the wound, and held aside by broad retractors. Now the operator should search carefully for the deep or inter-muscular fascia, immediately beneath which the posterior tibial vessels will be found. The situation from which the bleeding comes will point out whether it is the tibial or peroneal. If the latter be the artery wounded, most likely a good part of the flexor longus pollicis must be scraped off the fibula in order to find it, or (as Mr. Guthrie seems to have done) all the tissues around the bleeding point must be included in the ligature. If it be the tibial it may be exposed with rather less difficulty; still, it is a most difficult operation, as will be evident to any reader of Mr. Arnott's account, although in that case the wound was only recently inflicted, and Mr. Arnott had able assistance at hand. In cases where much blood has been infiltrated into the leg, obscuring all the neighboring parts, or where the surgeon is not very much versed in operations, or has to trust mainly to his own hands, it would perhaps be a better course to amputate; but I may be excused for repeating that properly-applied and carefully-graduated compresses, or the prolonged pressure of a finger in the wound, enlarged if necessary, would often render either operation unnecessary. In a recent traumatic aneurism, probably one of the various methods of applying direct or indirect pressure would succeed. If any operation became necessary, most surgeons would prefer to tie the femoral artery. Some, perhaps (but they would be very few), might treat the case, like a wounded vessel, by the old operation.

If the posterior tibial artery requires a ligature in the lower part of the leg, the operation is more simple, on account of the less depth at which it lies. An incision is to be made, about three inches in length, parallel to the inner border of the tendo Achillis, and the vessel is to be sought on the outer side of the two large tendons which pass behind the inner malleolus, that of the flexor longus digitorum being the nearest to the vessels. Behind the ankle the tendon of the flexor longus pollicis is on the opposite (external) side of the artery, but in ordinary cases will not come into view.

The popliteal artery has also been tied on account of subcutaneous rupture, unsuccessfully as far as the result of the case went, since gangrene set in on the third day, followed by amputation and death; but no difficulty was experienced in the operation,[1] which is thus described by the operator:[1] "Mr. Poland made an incision from seven to eight inches in length along the course of the popliteal artery, and cleared out much coagulum, and without difficulty found the ends of the ruptured artery lying an inch and a half apart; the upper end seemed to be plugged by coagulum, and was secured by ligature; the lower end seemed to be patent, and was similarly ligatured. The popliteal vein was distinctly seen, and appeared to be uninjured."[2]

In the Lancet for August 28, 1869, will be found an interesting case in which Mr. J. D. Hill tied this artery to check the growth of an encephaloid cancer of the leg. The patient survived nearly four months, but died of hemorrhage from the diseased tissue. The operation seems to have been unattended with difficulty, and being performed on parts free from extravasation or swelling, was accomplished with a shorter incision than in Mr. Poland's case. Mr. Hill gives a diagram of the anastomotic circulation, which is described as being carried on "by the anastomotica and superior internal articular arteries communicating directly with the anterior tibial recurrent, and by the descending branch of the external circumflex artery receiving the superior external articular, and inosculating with a branch of the anterior tibial recurrent. The posterior tibial artery was supplied by the inosculation of some muscular twigs arising from either (tibial) artery, and passing across just opposite the anterior tibial recurrent. The posterior tibial was small and contracted."

Popliteal Aneurism.

Although popliteal aneurism is so frequently curable without operation, yet operations for its cure constitute the great majority of those performed for aneurism.[1] The popliteal artery is so frequent-

[1] In the only two other cases, however, reported in Mr. Poland's paper, where the artery was sought for, the operation proved impracticable. The femoral artery has also been tied on account of this injury in two cases, but gangrene and death followed in both. Mr. Poland speaks in terms of merited reprobation of the practice.

[1] Guy's Hospital Reports, 3d series, vol. vi.

[2] On examining the parts after the amputation, Mr. Poland found that the knee-joint had been laid open by an extensive laceration of the posterior ligament, a complication which would probably have precluded recovery even had gangrene been averted; and as this same complication was present in three cases successively admitted into Guy's Hospital (the first three in Mr. Poland's collection), the point ought to be carefully investigated during the operation of tying the artery for rupture, by passing the finger into the deep parts of the wound, when if either condyle of the femur can be felt bare, amputation should be performed.

[3] In the Med. Times and Gaz. (supra cit.) seventy-five cases of ligature of large arteries

ly diseased, because it is liable to strains both in flexion and (though to a much less degree) in forced extension of the joint;[1] also because it is the end of a large tube, convex alternately forwards and backwards, which divides abruptly into much smaller branches, and is supported only by fat, while its branches plunge at once among muscles.

The symptoms of popliteal aneurism are usually quite characteristic.[2] The attention of the patient is called to the part by the tumor or by pain and stiffness of the limb, or by the pulsation—very commonly the latter; and on examining the part the surgeon is left in no doubt of the nature of the complaint. The aneurismal bruit is usually distinct, though cases are sometimes met with in which it is absent. The feeling of the pulsation differs somewhat according as the aneurism is growing towards or away from the joint; that is, according as it is situated on the front or the back of the vessel. The more usual position appears to be at the back of the artery towards the skin of the ham; and then the pulsation is of the usual equable heaving and expansive character. But when the aneurism is growing towards the joint, and the artery therefore is raised upon its posterior surface towards the skin, the pulsation feels much more thrilling, and a distinct line of separate pulsation often marks the course of the vessel. The position of the aneurism also materially influences the probability of complications involving the joint. A large tumor rapidly growing on to the posterior ligament of the knee, must cause considerable irritation in the joint; and synovial inflammation from this cause is a frequent accompaniment of popliteal aneurism. Still further, the resistance of growth of the sac afforded by such firm structures as the bones and ligaments of the joint soon leads to ulceration, so that such aneurisms are liable to burst into the knee-joint; the symptoms and indications of which event have been pointed out on pp. 324, 357.

Fig. 331.

Section of a popliteal aneurism. The section runs perpendicularly through the artery above; a probe marks the course of the lower part of the vessel (Museum Royal College of Surgeons, No. 1703).

The part of the artery affected varies, but the aneurism usually presents in the middle of the popliteal space, and bulges out below either hamstring. On dissection, the opening in the artery is most commonly found near its lower end.

The ordinary relations of popliteal aneurism are well shown in a preparation by John Hunter in the Museum of the Royal College of Surgeons, of which the annexed figure is a copy. (Fig. 331.)

Treatment.—The treatment of popliteal aneurism is usually successful, since such tumors partake of the nature of the milder forms of traumatic aneurism, and often occur in comparatively healthy persons. Besides, there is a long tract of artery above the tumor in the most favorable position for compression, and the anastomotic branches come off in tolerable profusion just above the tumor, and enlarge readily.

Before other severer measures are tried, genuflexion ought undoubtedly to be attempted. If bending the knee to its full extent stops the pulsation in the tumor, the best hopes may be entertained of its success. The kind of aneurism most adapted for it appears to be that which is situated on the back of the artery, and has not yet got very near the skin. In a tumor which appears on the point of bursting, it would be imprudent to insist on its trial; nor would it be likely to suc-

are reported, of which fifty-one were of the femoral, in almost all cases for popliteal aneurism.

[1] Very few sedentary persons or females suffer from this disease. In Norris's table, out of 155 patients, 5 only were females.

[2] Further observations on the diagnosis of bursal and other tumors in the ham from aneurism will be found in the essay on Diagnosis and Regional Surgery.

ceed if the pulsation were unaffected, or even (which seems theoretically possible) increased. Pressure, instrumental or digital, on the femoral artery may succeed when flexion fails, or a combination of the two may appear more efficacious, and is easily arranged. In applying pressure, it is important to remember that the artery changes its relation to the bone in its course down the thigh, and that in order to command the circulation with the least possible force, the pad ought to be directed towards the femur. The method of applying pressure in this situation has been discussed above.

If under the use of pressure the tumor is making visible progress, the femoral artery must be tied;[1] and this becomes still more necessary if the sac have burst; since, if the operation be delayed, the occurrence of gangrene will probably necessitate amputation.

Amputation also becomes necessary on the failure of the ligature, except in some rare cases of recurrent aneurism, when the femoral can be tied in Hunter's canal (see supra, pp. 355, 356).

Ligature of the femoral artery.—The femoral artery may be tied at three parts of its course: (1) above the origin of the profunda; (2) at the apex or lowest point of Scarpa's triangle; (3) in the canal formed by the tendinous fibres which connect the adductor magnus with the vastus internus. Of these, the last proceeding, that originated by Hunter, is now disused, unless for exceptional cases of recurring aneurism, such as Sir A. Cooper's, above quoted; and the second is the one generally employed in popliteal aneurism; the first being reserved by most surgeons for certain cases of aneurism in the thigh, and as a preliminary to some operations.

The great advantage of Scarpa's operation, for securing the artery, just as it is being crossed by the sartorius muscle, is that the vessel is exposed at a point where it is superficial, and therefore easily found; while at the same time it is far from the origin of any large branch. The operation in a natural condition of parts and a patient not very stout is usually easy. If the outline of the sartorius muscle is plainly perceptible, this will perhaps be the easiest and surest guide. Otherwise a line drawn from the centre of the fold of the groin [that is, from a point midway between the anterior superior spine of the ilium and the symphysis pubis] to touch the inner border of the patella when the foot is a little abducted, will mark the course of the vessel. An incision three or four inches long having been made in this direction through the skin and subcutaneous tissue (in which it will be well to avoid any large branch of the saphena vein), the fascia lata will be recognized, and should be divided on a director to the whole extent of the wound. This should expose the inner edge of the sartorius, which must otherwise be sought for by dividing the cellular tissue carefully without going deeper into the wound; and when the muscle is recognized, but not before, the sheath of the vessel is to be sought. It is generally found at once, by drawing the muscle slightly outwards, and the pulsation is felt. A nerve is usually seen in front of the artery, and must be excluded from the ligature. This may be either the internal saphenous nerve or a smaller branch of the anterior crural.[1] A small opening is to be made in the sheath, and enlarged to such an extent that the artery is fairly exposed; and then the vessel should be so far cleaned as to allow the aneurism-needle to be passed round it without material resistance. The great danger at this step of the operation is lest the vein should be injured, or should be included in the ligature. To avoid the first mistake, great gentleness is required in cleaning the artery and in passing the needle round it; while the second seems impossible if the vessel have been once fairly and cleanly exposed. The position of the vein must be accurately remembered; it lies almost directly behind the artery, inclining perhaps a little to its inner side. Hence we are usually recommended to pass the needle from within outwards. This being so, if the front of the artery have been once cleanly denuded, and the point of the needle have been fairly applied to it, it seems impossible that the needle can be thrust to the deeper side of the vein, without an amount of violence which is never used on the living subject; nor can the needle even perforate the septum which separates the artery from the vein, so as to wound the latter, without more force than is justifiable. If the occurrence of venous hemorrhage shows that

[1] A case cured by acupressure is referred to on page 358. [See also the chapter on Treatment by Esmarch's Bandage, p. 368.]

[1] A small nerve is often seen on the front of the sheath, but the saphenous nerve itself does not come into connection with the artery so high up as the usual seat of operation. Where it is in relation with the sheath, it lies rather external to the position of the artery, firmly bound down by a separate layer of fascia, which appears to form a portion of the sheath. Hence, if the sheath is opened only by a small puncture over the inner part of the vessel, the nerve will not come into sight.

the vein has been punctured,[1] the bleeding ought to be commanded by pressure, which is not difficult, and the operator must make up his mind either to abandon the operation for the time, and seek the vessel at a higher part of its course after a few days, or (which is perhaps the preferable course) to enlarge the incision upwards, and tie the artery with more care, about an inch above the spot originally selected. The ligature should on no account be tightened in the part where the needle has first wounded the vein, since in this way the thread would be left in the vein to act as a seton, and phlebitis could hardly fail to ensue, and would most likely prove fatal. If the needle have glided round the vessel without any such accident, the next step is to determine that the tissue embraced by it is really the artery, and nothing else. This is easily ascertained by pressing lightly on the tissues raised by the needle, and examining the part with the finger. The pulsation of the vessel will be felt; on making pressure, the beating of the aneurism will cease at once; while, if any doubt exists on that point, the absence of congestion shows that the vein is not included. Nothing then remains to be done except to tie the ligature firmly, and close the external wound with strapping or sutures.

In a case of ligature of the femoral artery which is to do well, the warmth of the foot, which is maintained by wrapping the limb in cotton wool, remains slightly above that of its fellow for a few days; the patient lying quiet does not notice the numbness and partial paralysis which would no doubt manifest themselves if he tried to move about; sensation is perfect; the ligature may be expected to fall any day after the first week.[2]

The chief danger after the operation is from gangrene. In Dr. Norris's statistics,[3] of 204 operations (for all causes), fifty died. Out of these fifty, the cause of death is not stated in four; and of the remaining forty-six, twenty-three, exactly one-half, died from gangrene, while hemorrhage proved fatal in eight cases only; five of the remaining deaths are attributed to phlebitis, one to sloughing of the sac, and the rest to accidental causes common to all operations—tetanus, fever, hectic, pyæmia, etc.

Hemorrhage, however, occurred in numerous cases in which it did not prove fatal, having been arrested by pressure. In order to apply pressure effectually to the femoral artery when secondary hemorrhage takes place, a graduated compress should be fixed very carefully on the wound by means of a presse-artére, or the bleeding point should be commanded by the fingers of a relay of well-instructed assistants. Should these means fail to arrest the bleeding, the external iliac artery must be tied, or the limb amputated, unless the surgeon choose to cut into the wound, and tie up again the bleeding portion of the vessel. Mr. Erichsen declares himself in favor of the latter mode of treatment. The first is the course most usually prescribed in our surgical works; but it has always (according to Mr. Erichsen) been followed by gangrene. The ligature of the bleeding portion of the artery is an operation which must always be difficult, and which may prove impracticable; yet it should be attempted when the parts are not extremely swollen, and other circumstances are favorable.

In a case where Mr. Pollock had tied the femoral artery, at St. George's Hospital, secondary hemorrhage came on, apparently from the upper end of the tied artery, on the eleventh day—the ligature not having separated, though it was quite loose. In the absence of Mr. Pollock from London, I was sent for, and on consultation with my colleagues, determined to attempt to secure the vessel, and should this prove impracticable, to amputate. I succeeded without much difficulty in tying again the upper end of the artery, which was perfectly open, and the operation was so far successful, as hemorrhage did not recur during the eight days which the patient survived. The cause of his death was phlebitis leading to pyæmia.

Renewed ligature of a tied artery is, however, a formidable and uncertain operation, which should only be undertaken as an exploratory proceeding, preliminary to amputation, if this should be found necessary. In all cases of severe secondary hemorrhage, there seems little doubt that amputation is the safest measure for the patient, though it is one to which no surgeon would willingly resort.

A slight amount of gangrene is not always inconsistent with the preservation of the limb; while of the cases of more extensive gangrene, many are saved by secondary amputation. Six cases of suc-

[1] Slight arterial hemorrhage is sometimes observed as the needle is passed round the artery, and stops when the ligature is tightened. It proceeds, in all probability, from the wound of a minute branch near its origin from the vessel.

[2] The earliest period at which the separation of the ligature has been noted in a successful case, free from hemorrhage, appears to be the eighth day; but it rarely comes away before the eleventh. In one case it came away on the sixth day, but hemorrhage occurred. In 91 cases out of 137 it separated before the twentieth day; but it has been known to remain on the vessel up to the sixtieth day.

[3] Am. Journ. Med. Sci., Oct., 1849, n. s., vol. xviii., p. 313.

cessful amputation are recorded in Norris's table.

Porta's statistics give somewhere about the same mortality[1] as those of Norris. It may be said, however, that these statistics give an unfair view of the mortality, since many of the operations were performed by the older surgeons on exploded and unscientific principles; or that successful operations on the femoral artery are so common that they are not considered worth publication. But no such objections can lie against the statistics collected by Mr. Hutchinson[2] of the cases of ligature of this artery in metropolitan hospitals. Out of fifty cases, sixteen have died, or, in round numbers, one-third. Mr. Bryant's tables of amputation of the thigh at Guy's Hospital for all causes,[3] with which those collected by the present writer from St. George's Hospital[4] agree in all essential particulars, give a mortality considerably under one third. So that ligature of the femoral artery seems to have proved more fatal than amputation of the thigh in the practice of London surgeons during the last few years, taking all cases of each operation indiscriminately.

If it be necessary to tie the artery in Hunter's canal, which, however, can only be the case either for wound or after the failure of the common operation, the same line of incision will be made, but lower down; and it will be necessary to divide the muscles freely. Hence the operation is more protracted and bloody, but no important parts are endangered in either. The principal risk is of wounding the vein, or of including it or the saphenous nerve in the ligature.

[The method recommended for tying the femoral artery in Hunter's canal is to abduct and flex the thigh, and rotate it outwards so as to make the adductors tense; feel for the tendon of the adductor magnus, and make an incision four inches long, the centre of which is at the junction of the lower and middle thirds of the thigh, in the direction of the tendon, which is that of a line drawn from the spine of the pubis to the tubercle on the inner condyle of the femur. Divide the skin and subcutaneous tissue carefully, so as not to wound the internal saphena vein, and then the aponeurosis upon a director. Recognize the fibres of the sartorius and of the vastus internus, which are at right angles with each other, and by pressing the former inwards or the latter outwards the tendon of the adductor and the curved glistening fibres arching from it to the vastus internus are exposed. If the saphenous nerve is now encountered it should be traced upward, a director passed into the orifice through which it emerges, and the aponeurosis divided upwards; if the nerve is not seen the aponeurosis should be pinched up and divided close to the tendon of the adductor. The sheath of the vessels is next opened, and the artery separated from the closely adherent vein. The needle should be passed from within outwards.]

Femoral Aneurism.

Spontaneous femoral aneurism is regarded, with reason, as a more serious affection than popliteal, since the latter often affects persons whose vascular system is in all other respects sound, while the former gives much reason to suspect a generally atheromatous condition of the vessels, in which case the existence of organic disease of the heart, or of internal aneurism, is exceedingly probable. Every such case, therefore, should be carefully examined with reference to these points before the treatment is fixed. The diagnosis of an aneurism in the thigh can hardly be attended with difficulty. Some doubt might exist as to the vessel upon which it was seated, whether the superficial or deep femoral; but the doubt would not have much effect upon treatment. In traumatic cases, the diagnosis between simple and arterio-venous aneurism should be attended to; but enough has been already said upon that point; what follows will refer entirely to the treatment of common aneurism in the thigh. Rest, without any special treatment, has been known to lead to the spontaneous cure of femoral aneurism;[1] but it would not be good practice to delay the commencement of more active treatment beyond the day or two which is usually allowed in order to familiarize the patient's mind and body

[1] It would be wrong to quit the subject of the mortality after ligature of the femoral artery without noticing the fact that Mr. Syme tied the artery twenty-three times in succession without any unfavorable symptom (Principles of Surgery, 1856, p. 99). Still, in urging this remarkable fact as an argument against the use of pressure, I cannot help thinking that that distinguished surgeon has been misled by a success which must be exceptional in the practice of any operator, however skilful.

[2] Med. Times and Gaz., vol. ii., 1856, p. 515; i., 1860, pp. 12, 35, 62, 89, 117.

[3] Med.-Chir. Trans., xlii., 70.

[4] Med. Times and Gaz., vol. i., 1861, p. 358. See also St. George's Hospital Reports, vol. i., pp. 303–4, where the mortality of amputations of the thigh for all causes is exactly one-third.

[1] Luke, in Med. Gaz., May 9, 1845.

with his novel circumstances, unless the tumor were visibly decreasing in size. In all cases in which the sac has not burst, compression of the femoral in the groin ought to be tried, and will usually succeed, especially if there is opportunity for the careful application of digital compression. Nor if the sac has burst is the case by any means desperate. A careful examination will show whether pressure with the finger controls the further progress of the extravasation; if it does, compression of the femoral may be tried for a day or two, the case being, however, very carefully watched. On the failure of pressure, recourse is to be had to the Hunterian operation,[1] which can generally be effected below the groin, in the first part of the artery; but in cases where the tumor extends higher up, the ligature must be placed on the external iliac. The former operation will be described here, the other being appended to the section on Inguinal Aneurism.

Ligature of the common femoral artery is an operation which is not generally regarded with much favor, and which is, therefore, little practised for the cure of aneurism, inasmuch as the operator generally prefers to tie the external iliac. The reason of the supposed danger of the ligature of the artery in this situation is, the proximity of the ligature to large branches. The epigastric and circumflex iliac on the one side, must come off near the ligature if it is placed close to the fold of the groin; and the profunda on the other, if it is placed lower down. The neighborhood of these large branches would certainly appear likely *à priori* to lead to secondary hemorrhage; but some doubt is thrown upon this theoretical conclusion by the experience of the elder and younger Porter, the latter of whom reports three cases fully, and alludes to two others, in which the operation was performed by himself and his father, all of which were successful.[2] Dr. Macnamara, of Dublin, in a paper published in the British Medical Journal, October 5, 1867, refers to eight cases; all but two being successful. In one of the unsuccessful cases (Mr. Butcher's) the patient died from hemorrhage, which had occurred previous to the operation; in the other (Mr. Collis's) there was a high division of the femoral; the ligature had really been placed below the bifurcation (*i. e.*, it was not a case of ligature of the common femoral at all): the patient died of secondary hemorrhage.[1] To these cases must be added one under Dr. Gregson's care,[2] in which the artery was much diseased. Secondary hemorrhage took place; the external iliac artery was tied, but this did not control the bleeding; gangrene ensued, and the patient died.[3] But this operation has not as yet been performed sufficiently often to allow of our pronouncing a confident judgment; and it must be left to the discretion of the operator to select the proceeding which he may think best calculated to save his patient's life. [Probably the use of antiseptic catgut would diminish the special risk of hemorrhage attaching to ligature of the common femoral.] The ligature of the common femoral is certainly a far more easy and a less formidable operation primarily than that of the iliac. The artery can usually be felt pulsating; and nothing is necessary except to divide the soft parts over it carefully with a moderate incision, so as to apply the ligature (which should be carried from within outwards) without any exposure of the vein or other parts. The incision may be either longitudinal or transverse, and surgeons who have performed the operation differ as to the relative advantages of the two incisions. The crural branch of the genito-crural or a small branch of the anterior crural nerve may be found running down in front of the vessel, but can be easily avoided.

Another objection to which the ligature of the common femoral is exposed is the liability to gangrene, in consequence of the vessel being blocked up above the origin of both of the great nutrient arteries of the limb. The superficial femoral, which nourishes the lower part of the limb, is comparatively easily reinforced after the ligature by its free anastomosis with the profunda artery; but when both these channels are blocked up, the consequent strain upon the collateral circulation is much increased; and, for my own part, I must express my decided preference for the ordinary operation whenever there is a choice between the two. Yet, if the aneurism were seated in the thigh, and the ordinary operation were impra-

[1] This is the ordinary rule; but in cases where there is not much ecchymosis, and in some in which the diagnosis is obscure, the old operation may be performed successfully (see the cases referred to on pp. 341, 342).

[2] Dublin Quarterly Journ. of Med. Sci., Nov., 1860.

[1] New Syd. Society's Biennial Retrospect, 1867-8, p. 298.

[2] Med. Press and Circular, Sept. 2, 1868.

[3] Mr. Erichsen asserts, op. cit. (7th ed., 1878, vol. ii., p. 160), that although the ligation of the common femoral has several advocates, especially in Ireland, yet the statistics of the operation, *when performed for aneurism*, are by no means favorable, and that ligation of the external iliac is to be preferred.

ticable, I should prefer the ligature of the common femoral to that of the external iliac.[1]

In Norris's table, above referred to, the femoral artery was tied twenty-seven times for aneurism in the thigh, with only five deaths; a smaller proportion than that of ligature of the femoral from all causes. Unfortunately, it is not told us in how many of these cases the artery was exposed above the origin of the profunda; which must, I presume, have been the case in some, if not in most of them. The omission in so careful a compilation is doubtless due to the inadequacy of the original notes. In Porta's table, eight are said to have died out of sixteen; but no details are given.

Inguinal Aneurism.

Pulsating tumors are always to be viewed with some suspicion when they lie in close proximity to any bone possessing a copious diploe. Hence such affections about any part of the pelvis should always be very carefully examined before they are pronounced aneurismal. The records of surgery abound in instances of tumors in the gluteal and abdominal regions having been pronounced to be aneurisms of the large arteries of those parts, when they were really pulsating cancers of the bone; and many of the cases reported by the older surgeons were obviously of this nature, though the mistake was never discovered, and they stand amongst the list of aneurisms. Such a mistake is less likely to occur in the groin than about other parts of the pelvis; but the surgeon should be on his guard here also. A comparison of the pulse in the chief arteries of the two limbs will be of great service, since it is usually altered in aneurism and not in the pulsatile tumor; and the other points of the diagnosis between aneurism and pulsatile tumor should be carefully examined. (See p. 339.)

The diagnosis having been made, the question will occur whether the case is a fit one for compression, or whether the Hunterian operation must be performed. Compression on the external iliac, in persons not very fat, can be easily applied by the finger; and numerous instances of the success of digital pressure in this region are recorded. In the face of such facts, no surgeon would be doing his duty who exposed his patient to the great risks of an operation on the external iliac artery, without a well-considered and persevering attempt to cure the disease by pressure, whether digital or instrumental. In these aneurisms complete pressure, both proximal and distal, by means of a tourniquet applied to the artery above and another below the tumor, has been found extremely successful. The patient should be confined to bed for a few days, while the instruments are being got ready—for it is necessary to see that the compressors fit very accurately—and during this interval the way may be prepared by the application of digital pressure for the more serious endeavor to cure the disease. Then chloroform [or ether] should be administered, and the patient should be kept under its influence for the necessary length of time, whilst all circulation is suspended in the sac by pressure on the external, or if necessary on the common iliac, above and on the femoral below.

[See Prof. Sands's case, page 446, of compression of the common iliac by the hand introduced into the rectum. The current through this vessel has also been successfully controlled, during amputation at the hip-joint, by means of a stick, one end of which was padded, passed up the rectum, and made to press upon the artery (Davy's lever). Possibly the same instrument could be used in the treatment of aneurism.]

An instance of cure of inguinal aneurism by this means is recorded by Dr. Mapother,[1] in which the pressure was applied on the first occasion for seven, and on the second for twelve, hours; and instances of cure by long-continued compression between the heart and the aneurism only by Mr. Eck,[2] Mr. Lawson,[3] Mr. Hilton,[4] and others. In the last-named case there was also popliteal aneurism, which was simultaneously cured. I am informed, however, that in this last case the cure was not permanent in the popliteal aneurism, and the limb was afterwards amputated in the country.

It is possible, also, that direct pressure upon the tumor may assist in the cure, as it seems to have done in Mr. Luke's case, above referred to; but this should be

[1] In the year 1868 a patient was under my care in St. George's Hospital, in whom Mr. Smyly, of Dublin, had tied the common femoral artery in the groin for the cure of popliteal aneurism. The operation had been perfectly successful as far as the cure of the aneurism went; in fact, the latter was no longer perceptible. But the patient had lost the second and third toes from gangrene, as well as some of the skin at the inner side of the foot, and the cicatrix had ever since been so unsound that it broke down into a torpid ulcer on any slight cause. This had been a source of constant misery and loss of activity to him ever since the operation. I should, however, add that there had been some ulceration of this foot and leg before the femoral was tied.

[1] Dublin Med. Press, March 29, 1865.
[2] St. Barth. Hospl. Reports, ii., 190.
[3] Lancet, October 26, 1867.
[4] Med.-Chir. Trans., vol. lii., p. 309.

used very cautiously, if at all, since sloughing of the coverings of the tumor would most seriously complicate the case.

Ligature of the external iliac artery.—The operation for securing the external iliac artery is usually regarded as a very successful one; and relatively to the other operations on large trunk vessels, it may be so considered; but the mortality is still very great. Of 153 published cases taken indiscriminately, forty-seven died; a mortality exceeding that of amputation of the thigh.

The operation is performed by making a sufficient incision through the parietes of the lower part of the abdomen, the precise direction of which is not a matter of very great consequence, but which is usually drawn from a little above the centre of Poupart's ligature outwards (so as to avoid the direction of the epigastric artery) to a little internal to the anterior superior spine, from which point it may be curved inwards, as far as may be thought necessary, towards the umbilicus; or it may lie directly over the course of the artery. The muscles are to be divided to the same extent, care being taken in dividing the lowest strata, until the transversalis fascia is reached. This structure can generally be recognized immediately beneath the muscles, and should be divided in the iliac fossa, not far from the anterior superior spine, upon a director, after a hole has been cautiously made in it. [It is sometimes so thin and delicate that the operator may easily fail to recognize it; it should always be sought for as close to Poupart's ligament as the limits of the incision will allow, for there it is thickest and furthest removed from the peritoneum.] The operator will now find a cellular interval lying above the peritoneum; and that membrane, with the intestines, should be gently and gradually pushed over towards the middle line, until the vessels are seen or felt. The vein, it should be remembered, lies internal to the artery; and the genito-crural nerve, or lower down its genital branch, lies on the anterior surface of the vessel. The ligature must, therefore, be passed from within outwards; and if the nerve have been included in it, care should be taken to slip the thread away from under it before the knot is tied. The ligature of this little nerve need not, however, lead to any bad results. The accident which usually happens in this operation is, naturally, the laceration of the peritoneum. It is not necessarily attended with fatal or even serious consequences; in fact, a successful case was lately published in which the peritoneum had been divided by mistake for the transversalis fascia, to the extent of the external wound; but any injury to the peritoneum should nevertheless be most carefully avoided.

In principle, the various operations described on the iliac arteries reduce themselves to two methods, in one of which the artery is reached from below, while in the other it is approached from without or from above, as has been just described. The latter method is easier when the aneurism encroaches upon Poupart's ligament; the former when the tumor is situated lower down, and the whole of the artery may, therefore, be expected to be found healthy. There is little difference between the two plans, except that the operation from below requires a smaller incision, and is less difficult in appropriate cases; but if the artery be pressed back into the pelvis by a tumor extending up into the groin, it becomes much more difficult, if not impracticable, from adhesion between the tumor and the peritoneum. Sir A. Cooper, in describing the operation from below, advises that "the centre of the internal oblique and transversalis muscles should be raised from Poupart's ligament. The opening by which the spermatic cord quits the abdomen is thus exposed, and the finger passed through this space is directly applied upon the iliac artery." The rest of the operation then consists chiefly in scratching the fascia off the artery, separating the latter from the vein, and passing the ligature round it, which Sir A. Cooper directs to be done from without. Mr. Guthrie, however, justly observes that the vein is less likely to be injured if the point of the needle be first insinuated between it and the artery, and the ligature carried from within outwards.[1]

The points to be chiefly guarded against in the ligature of the external iliac artery are, wound of the epigastric artery, of the vas deferens, or other constituents of the spermatic cord, laceration of the peritoneum, puncture of the external iliac vein or of the circumflex vein, ligature of the genito-crural nerve, and a too free disturbance of the sub-peritoneal cellular tissue. The wound of the epigastric artery is only probable when the operation is practised from below. The vessel can, it is true, be secured, but the bleeding and loss of time are objectionable; and after it is tied, an important anastomosis is stopped up, and the chance of gangrene increased. The vas deferens also is only endangered in tracing the artery upwards. A knowledge of its position, and its peculiar cord-like feeling, will suffice to make the operator avoid it. The laceration of the peritoneum cannot always be avoided. Great gentleness should be used; and before the operation the patient should have been well purged, in order to obviate any distension of the intestines. The clean exposure of the artery is the best

[1] Guthrie's Commentaries, p. 268.

safeguard against wounding the vein or including the nerve. The circumflex iliac vein, which crosses the end of the artery, must be avoided in the operation from below. A careful selection of the method most appropriate to the case before him will enable the operator to reach the artery with the least possible disturbance of the deep cellular tissue. It is true that it may become absolutely necessary to disturb a large extent of the peritoneum from its cellular connections; but this should always be avoided as far as possible, since it greatly increases the risk of diffuse inflammation on one or the other side of the serous membrane.

In Norris's and Cutter's tables[1] of 153 cases of ligature of this artery for all causes, forty-seven died; out of these the cause of death is not stated in one, was doubtful in one, and in two was unconnected with the operation; of the remaining forty-three, seventeen died of gangrene, and three of sloughing of the sac, nine of hemorrhage, five of peritonitis, one of pelvic abscess, one of diffuse inflammation, three of prostration and exhaustion, one of pleurisy, two of tetanus, and one of delirium tremens. Two of the remaining cases were unaccounted for. In successful cases, the earliest period of the separation of the ligature was the tenth, the latest the sixty-second day. In fifty-two cases it came away before the twentieth day, and in thirty others before the thirteenth.[2]

Abdominal Aneurism.

Many of the pulsating tumors which are found in the false pelvis are of a cancerous nature; many of those which are undoubtedly aneurismal are seated upon the aorta, too high for surgical treatment. Thus, both the diagnosis and treatment of such tumors demands the most careful consideration. I can add nothing on the general question of the diagnosis between aneurism and pulsatile tumor of bone to what will be found above; and will here merely remark that the points most likely to be marked as distinguishing a tumor of the os innominatum from an aneurism of the iliac or gluteal artery would be the presence of swelling on both sides of the bone, and the appearance of cancer-cells in the urine, together with the equal beat of the pulse on the two sides. It would never be agreeable or advisable to commence an operation on the iliac vessels without having plainly heard the aneurismal bruit. But Mr. Moore's case above referred to (p. 338) shows that even this symptom may be deceptive.

As to the treatment of an aneurism in the belly, three plans suggest themselves: the employment of compression to the artery above, the use of medical means only, or the Hunterian operation.[1]

The successful treatment of abdominal aneurism by compression was first carried out by Dr. Murray, of Newcastle-upon-Tyne,[2] under chloroform; pressure being kept up on the first occasion for two hours, and on the second for five hours, with permanent success. In a case under the care of Dr. Heath, of Sunderland,[3] pressure had been kept up irregularly for ten hours, when the patient fainted under chloroform. The symptoms were as bad as ever. He was urged to bear a final effort without chloroform. This he did, and at the end of twenty minutes, when he declared he could bear it no longer, the aneurism had become solid and had ceased to beat.

[In another case Mr. Durham (Med.-Chir. Trans., vol. lv., p. 213) cured an abdominal aneurism that extended from about "an inch below the cartilages of the false ribs to the level of the umbilicus, and from the right of the median line to about midway between the median line and the left border of the abdomen" by pressure with Lister's tourniquet on the aorta above the aneurism for ten and a half hours. The aneurism was subsequently found to be of the superior mesenteric artery, involving its orifice. Mr. Holmes (Lancet, 1873, i., p. 193) thinks that "gradual compression without chloroform may be in many cases preferable to the more rapid method."]

The Hunterian operation for abdominal aneurism may be practised on the common iliac artery, or on the lower part of the aorta. In some cases it may perhaps be possible to secure the upper part of the external iliac for aneurism situated above the groin; but this operation has been already described.

The operations for securing all the iliac arteries are similar in principle, and identical in most of their details. The same incision serves to reach them all—only to reach the common or internal iliac the

[1] Am. Journ. Med. Sci., vol. xiii., 1847, p. 13; vol. xlviii., 1864, p. 36. There seems an error in Dr. Cutter's statement of his results. He tabulates 14 deaths, but only reckons 13.

[2] A successful case of ligature of the external iliac with silver wire has been recorded by Dr. Martin in the Am. Journ. of Med. Sci., October, 1866, p. 580.

[1] The old method has been adopted here also; but its results, I believe, have been, and would always be, uniformly fatal.

[2] Med.-Chir. Trans., vol. xlvii., p. 187. Dr. Murray speaks of the experiment of curing abdominal aneurism by pressure as one previously unthought of—not having met with the recommendation of the plan in the first edition of this work.

[3] Brit. Med. Journal, Oct. 5, 1867

incision must extend further upwards, and must be longer, in consequence of the greater depth at which the internal

[Fig. 332.

Ligation of the common iliac. (Liston.)]

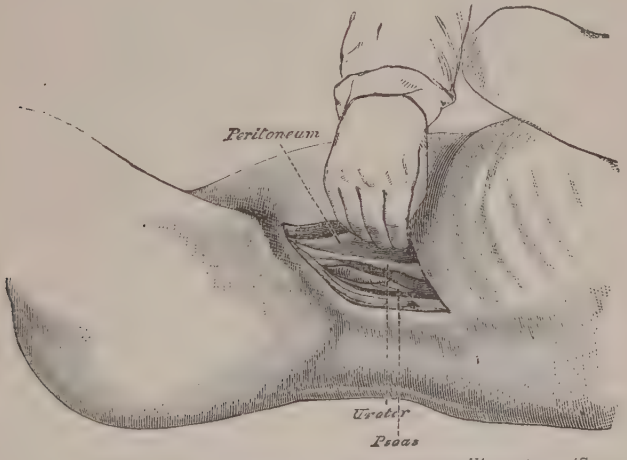
iliac lies, and the higher position of the common iliac. Hence the surgeon can determine during the operation which vessel he will select, according to the extent of the tumor and the appearance of the artery when exposed.[1]

In applying a ligature to the *common iliac*, the operator must remember the situation of the large veins which run with the artery of each side; and he must be careful to look out for the ureter, both to avoid including it in the ligature (of which, however, there is little risk), and to avoid doing it any other damage.

The common iliac may also be tied by an operation behind the peritoneum similar to that which is used in experimental operations on the lower animals for tying the abdominal aorta.

Sir P. Crampton's case is well known, and his operation is a good illustration of the method of reaching the artery from above the tumor. An incision was made from the end of the last rib obliquely forwards and downwards to the crista ilii, and then curved forwards above and parallel to the crest of the ilium, terminating at the anterior superior spine. The muscles and fascia transversalis were cut through at the bottom of the incision till the subperitoneal interval was reached, and then the peritoneum being held back by the front of the finger, a probe-pointed bistoury was run along the back of the finger, and so, by repeated strokes of the bistoury, the muscles were divided to the extent of the external wound. Sufficient

[Fig. 333.



Incision for the application of a ligature to the aorta or common iliac artery. (Crampton.)]

room was thus obtained to pass in the whole hand, and raise the peritoneum and intestines from the fascia iliaca. The parts were then plainly visible, and the vessel easily secured.[1]

my finger, beating awfully, at the rate of 120 in a minute, its yellowish-white coat contrasting strongly with the dark blue of the iliac vein which lay beside it, and seemed nearly double its size. The ureter, in its course to the bladder, lay like a white tape across the artery; but in the process of separating the peritoneum, it was raised with that membrane, to which it remained attached."—Med.-Chir. Trans., vol. xvi., p. 162.

[1] Guthrie, Commentaries, p. 262.

The artery may also be reached by an incision through the peritoneal cavity, similar to that by which Sir A. Cooper cut down upon the abdominal aorta; but this plan should never be followed if either of the others are practicable.

[This statement is still in accord, I believe, with the views held by the most experienced surgeons, notwithstanding the successes obtained in ovariotomy and laparotomy with and without antiseptics. Yet, quite recently, October 17, 1880, Prof. H. B. Sands tied the left common iliac artery at the New York Hospital unsuccesstully for an aneurism of the external iliac. The aneurism was so adherent to the overlying peritoneum that it was not considered prudent to strip the latter off; Prof. Sands, therefore, passed into the peritoneal cavity, scratched through the peritoneum covering the artery, and applied a catgut ligature. The external incision was nearly vertical, about three inches to the left of the median line, and about five inches long. Full antiseptic precautions were taken, a drainage tube inserted, and the wound closed with silver sutures. The wound healed promptly, and the patient recovered with the loss of the foot by dry gangrene. The aneurism was cured. About three months after the operation, and before the foot had separated, a slough formed over the head of the fibula as the result of pressure, and finally, January 16, 1881, the limb was amputated above the knee.]

The statistics of the ligature of this great vessel are most gloomy, the recoveries having been only exceptional. In the American Journal of Medical Sciences for July, 1860, Dr. Stephen Smith collected all the cases known then to have occurred, thirty two in number,[1] of which only seven terminated in recovery; and in one case at least the patient appears to have died under the operation. The causes of death were noted in nineteen cases; and it is remarkable that gangrene was the alleged cause in only three instances; the others were "exhaustion" eight, hemorrhage six, and peritonitis two. In successful cases, or cases uncomplicated by hemorrhage, the ligature may be expected to separate in about three weeks.[1]

Ligature of the abdominal aorta.—Sir A. Cooper's case, the first in which the abdominal aorta has been tied, is well known.[2] The patient was suffering from aneurism, which appears to have involved the left common iliac artery, and the vessel below it to some extent. It had burst through the skin, and the patient was greatly reduced by hemorrhage. Sir A. Cooper endeavored, by making a small puncture into the aneurism which he could plug with his finger, to reach the opening of the artery, with a view of tying it on both sides of its communication with the sac—the operation since practised by Mr. Syme. But as he could not reach the vessel by this means, he determined to give the patient the "only hope of safety" which remained for him, by putting a ligature round the artery above the tumor—the aorta. The operation was accomplished by an incision through the linea alba, three inches in length, its centre corresponding to the umbilicus; the peritoneum was opened to about the extent of the skin-wound; the intestines, which were completely empty,[3] did not protrude; the finger was passed down between their convolutions on to the spine, where the aorta was felt beating violently. The peritoneum was then scratched through with the finger-nail, and the point of the finger was insinuated below the vessel. The aneurism-needle was then conveyed round the aorta, and the ligature tied. In doing this, great care was necessary, to avoid including the intestine or omentum. Sir A. Cooper's patient survived forty hours; Mr. James's died the same evening. These cases, to say nothing of the numerous instances in which the artery has been successfully tied in the lower animals, certainly show the possibility of survival after the operation; and accord-

[1] Dr. Smith has divided his cases into four groups: 1, for arrest of hemorrhage in wounds, or in surgical operations, eleven cases, only one of which recovered; 2, for aneurism, fifteen cases, ten deaths; 3, for pulsating tumor mistaken for aneurism, four cases, one recovery; 4, to obviate hemorrhage in an operation in one case, and in an aneurism for anastomosis in the second, two cases, both of which died. It is perhaps hardly presumptuous to say, after this experience of the operation, that most of the cases never ought to have been submitted to ligature; and that the operations in the first class would now be unjustifiable.

[1] Mr. Erichsen adds eight cases, and reckoning as successful one of the cases tabulated by Smith as fatal (since the patient appears to have died from a different cause after the closure of the wound), he gives thirty deaths and ten recoveries.—Sci. and Art of Surgery, 7th ed., 1878, vol. ii., p. 153.

[2] Surgical Essays, by Cooper and Travers, vol. i., p. 128.

[3] Sir A. Cooper adds the remark, that in this operation it is essential to have the bowels well emptied; and the truth of this observation was exemplified in the next case in which the artery was tied, by the great trouble experienced by the operator (Mr. James) in consequence of the tympanitic condition of the intestines.—Med.-Chir. Trans., vol. xvi., p. 1.

ingly the operation has been repeated several times,[1] not however, on Astley Cooper's plan, but by an operation similar in most respects to Sir P. Crampton's on the common iliac artery; that is to say, by a free incision through the abdominal walls, somewhat far back, carried down to the fascia lining them; then making a cautious division of this fascia to the extent of the wound, gradually pushing over the peritoneum and intestines, and directing the fingers towards to the front of the spine, where the pulsation of the great artery will easily be felt. But though it is easy to feel the artery, there is much difficulty in getting the finger round it, and in separating it from the important parts which lie around.

Many most interesting questions present themselves in considering the justifiability of this daring experiment in operative surgery. Our space will not allow of their adequate discussion; but the main considerations must be summarily stated. First, is there really any rational prospect of recovery? One of the patients (Monteiro's) survived ten days, so that it would be rash to deny that there is. Still we must not forget that such an operation is never undertaken except upon a patient in the extremity of a disease probably affecting the whole arterial circulation, one in a very different condition from a healthy animal, or even a healthy man. Secondly, allowing the theoretical possibility of recovering, is the practical chance of it ever equal to that of spontaneous cure? Sir A. Cooper's case certainly was one, to judge by his description, in which such a cure was impossible, since he had laid open the tumor in an unsuccessful attempt to perform the old operation; and hemorrhage must soon have occurred, and could hardly have failed to prove instantly fatal, so that some operation was inevitable. But, thirdly, is it ever necessary to secure the aorta itself? Mr. Guthrie believes, on the contrary, that when an operation is possible, the common iliac artery above the tumor could always be reached by making the incision on the opposite (sound) side, as if to tie the common iliac of that side, and then passing over from that artery, when it has been found, to the one on the side of the disease.[2] The old operation might be attempted, but would be very liable to fail, from the fact of the sac passing into the pelvis, and so perhaps pressing the opening of the artery out of sight; or galvano-puncture might be tried in a case which seemed suitable for it. In such desperate circumstances probably any treatment would be unavailing to prolong life; but the risk of doing harm by any treatment is not great, since the patient's life will not last under any circumstances more than a few days. On the whole, however, the natural repugnance of surgeons to perform great operations which cannot be expected to succeed, will either banish this altogether from practice, or restrict it to a very few exceptional cases.

[1] By Murray, Med. Gaz., 1834, vol. xiv., p. 68; Monteiro, Schmidt's Jahrb., 1843; South, Lancet, 1856, vol. ii., p. 222; M'Guire, Am. Journ. of Med. Sci., Oct., 1868, p. 415; and with a temporary compressor by Dr. Stokes, Jr., of Dublin (see page 358).

[2] Commentaries, p. 265.

Gluteal Aneurism.

Pulsating tumors in the buttock, of spontaneous origin, are usually found to be of a cancerous nature, and connected with the innominate bone; but aneurism of the gluteal or sciatic artery may occur unconnected with wound, and in the Museum of the College of Surgeons there is a preparation by John Hunter of an aneurism of the internal pudic artery. The diagnosis, however, should be very clearly established before the extremely dangerous measures necessary for the treatment of gluteal aneurism are recommended. The points to which principal attention would be directed would be, whether any tumor is present in the iliac fossa; whether the bruit is of the true aneurismal character; whether any bone can be felt in the envelope of the tumor; whether the pulsation resembles that of aneurism (expansive) or that of pulsatile tumor (rapid and heaving); and, finally, whether any sign of constitutional affection can be detected. Mr. Guthrie's case,[1] however, shows that the greatest experience in aneurism cannot always insure against errors of diagnosis.

If the existence of aneurism appears certain, two courses are open to the surgeon; viz., to perform the old operation with the precautions against sudden and excessive hemorrhage which Mr. Syme adopts, or to tie the internal iliac artery. The former course can only be recommended when the aneurism is of traumatic origin, since in that case the artery will be sound, and the wound in it will be within reach; while in a spontaneous aneurism, besides the risk of putting the ligature round an unsound artery (which, under the circumstances, is a minor consideration), the orifice of communication may be within the pelvis, and the old operation absolutely impracticable. Mr. Syme relates an example of each form of

[1] Med.-Chir. Trans., vol. xxviii., p. 308.

aneurism.[1] and each method of treatment, which was successful in both instances.

[In the winter of 1879–80 Prof. H. B. Sands treated a gluteal aneurism at the Roosevelt Hospital, N. Y., by compression of the common iliac artery by the hand introduced into the rectum. Two trials were made at an interval of a week, the compression being maintained for an hour and a half each time. Pulsation remained almost entirely absent for some hours after each trial, and then returned in full force. A third trial was made about a fortnight after the second, and the pressure kept up for three and a half hours, but the apparent consolidation was less than after either of the preceding attempts. Ether was used, and no ill result followed the distension of the bowel. Subsequently, intermittent compression of the aorta by means of a tourniquet, for periods varying from one to six hours, was practised for a month, but with no benefit. The patient was then dismissed, and I am told that now, December, 1880, he is still living and in about the same condition as before the operation.

An interesting and important fact in the case was the diagnostic aid furnished by the rectal exploration. The internal iliac artery was recognized by the finger, and found to be greatly dilated, its dilatation increasing from above downwards until the artery left the pelvis. The case is reported in full in the Am. Journal of Med. Sciences, April, 1881.]

No further description is necessary here of Mr. Syme's method (or revival of Astley Cooper's method) of performing the old operation, as it has been already described on p. 343. I shall, therefore, proceed to describe the ligature of the internal iliac artery.

The internal iliac should only be tied for aneurism of one of its branches, or for a wound within the pelvis in which pressure will not stop the bleeding. In this case, however, the operation, which is one in itself of great danger, should be practised only after very careful deliberation. The artery has been secured in order to stop hemorrhage from a wound in the buttock; but the practice has been justly censured by Mr. Guthrie.[2]

[1] Obs. on Clinical Surgery, 1861, pp. 165–173.

[2] Commentaries, p. 270.

The operation much resembles that above described for placing a ligature on the common iliac (see p. 443). Having, by the steps there prescribed, arrived at the lowest point, or bifurcation, of the common iliac artery, the operator must follow down the internal iliac into the pelvis, his finger being laid across the external iliac vessels, which may, if it be practicable, be shielded by a curved spatula from all chance of injury. It is desirable to place the ligature at a distance of about ½ to ¾ inch below the bifurcation. The vein lies behind the artery. The spot at which the ligature is to be placed having been fixed, the surgeon scratches the artery free from its connections with his finger-nail, and then proceeds to pass the ligature; in doing which Mr. Guthrie says that it is desirable if possible to see the vessel, and for this purpose directs that the lips of the wound be retracted. The artery, however, lies at so great a depth that it can only be brought into view if the person be spare. Great care accordingly is required to avoid wounding the peritoneum, the ureter, and the vein which accompanies the artery. The termination also of the inferior mesenteric vessels (superior hemorrhoidal) may be injured in operating on the artery of the left side.

The cases in which this operation is required must be very rare. Of seven cases contained in the American Journal of Medical Sciences (vol. viii.), three recovered, and four died. Mr. Syme's successful case is to be added to the recoveries, and a case by Mr. Atkinson to the list of deaths;[1] so that the operation has been sufficiently successful to encourage its repetition.

[The subject of ligation of arteries will be further referred to in Vol. III., in the article on Operative Surgery, and concise directions given as to the mode of securing each vessel.—P.]

Note [to 2d English edition].—The Sections on Digital Pressure, Manipulation, Galvanopuncture, Coagulating Injections, Arteriovenous Aneurism, and Cirsoid Aneurism, are re-edited from the originals written by Mr. Hart.

[1] Erichsen, op. cit., p. 107.

[INJURIES AND DISEASES OF THE ABSORBENT SYSTEM.

By Samuel C. Busey, M.D.

Anatomy and Histology of the Lymphatic System.

The lymphatic system consists of large and capillary vessels, interstitial spaces or juice tracks, lacteals, follicles, and glands. Anatomists have divided the vessels into two sets: the superficial and deep-seated. The former are located in the subcutaneous tissue and accompany the veins; in the solid viscera they lie under the capsule, and in the tubular viscera under the serous membrane. The deep-seated vessels are fewer in number, but larger than the superficial, and accompany the deep-seated bloodvessels. In the solid viscera they ramify through the interior of the organ and emerge at the hilus; in the tubular viscera they lie beneath the mucous membrane, forming by free anastomosis a plexus in the submucosa. The vessels of each set anastomose very freely, but there is rarely any direct communication, except in the viscera, between the vessels of the two sets, but they frequently connect with the same gland. By their peculiar manner of anastomosis, plexuses with large meshes are formed, so that an entire set can be injected, if several vessels can be successfully filled. This arrangement favors the rapid spread of inflammation and conveyance of noxious material from vessel to vessel. As a rule the vessels are uniform in size from their beginning to their termination, but in consequence of the number and arrangement of the valves, they frequently present a moniliform appearance.

Recklinghausen has more properly divided the lymph vascular system into two parts: the first is the interstitial spaces, which contain the fluid immediately after it escapes from the bloodvessels and convey it around the several elements of the tissues; the second is the system of efferent canals—the lymphatic vessels proper. These efferent canals are divided into capillaries, and the larger vessels which issuing from the organs, unite and form the trunks. They agree ordinarily in form, structure, and arrangement with the veins.

"The lymph-capillaries are not continuous with the blood-capillaries, but are arranged in a network, which lies in the meshes of the plexus formed by these vessels, from which they are separated by intervening tissue-elements." (Curnow.) They are very numerous in the skin, aponeuroses, serous and mucous membranes, solid viscera, ductless glands, and on the surface of muscles. Their walls are composed of a single layer of endothelium resting upon elastic tissue. In their continuity they present a sinuous outline, and are provided with an incomplete valvular arrangement.

The larger vessels have three coats, a tunica intima, consisting of a layer of elastic fibres, arranged longitudinally, and lined by a single layer of tessellated endothelium; a tunica media, composed of muscular and elastic fibres, some arranged circularly, and a few longitudinally; and a tunica adventitia, composed of connective-tissue, with a few elastic and muscular fibres. Their walls are thinner than those of the arteries, but are, in thickness, proportionate to the calibre of the vessel, more like the coats of the veins. They are provided with numerous valves, usually semilunar in shape, formed by duplicatures of the inner coat, and attached by their convex edges to the walls, the free borders being in the direction of the lymph-current. Valves are more abundant in the superficial vessels than in those between the muscles, and are placed at shorter intervals in all vessels the nearer they approach the glands.

The whole lymph vascular system terminates either in the right or left thoracic duct. The right duct is about one inch in length, and does not exceed a line and a half in diameter; it receives the lymph from the right side of the head and neck, the right upper extremity, the right lung, the right side of the chest, the right side of the heart, and the convex surface of the liver, and terminates at or near the junction of the right subclavian and right internal jugular veins. The left, usually known as the Ductus Thoracicus, conveys the lymph from the remaining parts of the body, and the chyle. It begins at the Receptaculum Chyli,

which is usually located on the body of the second lumbar vertebra. From this point it ascends between the aorta and vena azygos major to the fourth dorsal vertebra, thence inclining to the left side, passes behind the aorta to the upper border of the seventh cervical vertebra, and, curving downwards from this point, terminates in the left subclavian vein, near the junction of the internal jugular. It passes through the aortic opening in the diaphragm. At its beginning it is four lines in diameter, diminishes in its middle portion, and again enlarges in the terminal portion. It is flexuous in its course, varicose in appearance, and is supplied with many valves, which are placed at shorter intervals in the upper than in the lower part. Both the right and left duct are provided with valves at their openings into the veins. Their walls are composed of three coats: the inner, consisting mainly of a layer of endothelium; the middle, of smooth muscular and transverse elastic fibres; and the outer, of connective-tissue. In the outer tunic lie the vasa vasorum and nerves.

The origin of the lymphatics has not been definitely settled; various hypotheses have been advanced, but no one of them has been universally accepted. Recklinghausen first demonstrated that lymph circulated in the connective-tissue interstices, and expressed the opinion that these spaces were in open communication with the lymph-channels. The direct communication between the spaces and tubular channels has not been conclusively demonstrated, but recent investigations seem to have established the fact that the spaces of the connective tissue are "lymph reservoirs, and that the lymph-capillary is their discharge-pipe." These interstices are lined by an endothelium presenting the peculiar characteristics of lymphatic endothelium, which is constituted of cells of nearly equal length and breadth, with well marked dentated borders. Recent observers characterize all spaces lined with these peculiar cells as lymph-chambers. The connective-tissue spaces are not then simple interstices, but lymph-lacunæ, differing only in size from the serous cavities. The interstices between the acinous glands of the duodenum, those in the connective-tissue of the salivary glands, the spaces between the muscular fibres of the heart, between the choroid and sclerotic, the sub-arachnoid space, and the lacunar spaces found in the testicle, are all embraced in the category of lymph-chambers. These cells have been traced by Axel Key and Retzius through the brain, and along the spinal cord and nerves to their final distribution. Lymphatic sheaths envelop the arteries of the brain and spinal cord, as also the vessels of the retina, those in the interior of many glands and in other situations, "in the same manner as the pericardium envelops the heart, and the peritoneum the intestines, and so resemble the serous cavities in miniature." (Curnow.) His and Obersteiner claim to have demonstrated a communication between the epicerebral space and these perivascular spaces; and the latter insists that there are spaces around the ganglion cells of the brain, which he denominates pericellular lymph-cavities.

The serous cavities are now considered lymph-chambers, and the loose cellular tissue (Küss) a "vast chambered lymphatic sac, communicating directly with lymphatic vessels." The bursæ mucosæ and synovial sheaths of tendons are intermediate between the connective-tissue interstices and the serous cavities. Plexuses of lymphatics lie under the endothelium of the synovial membranes, but their communication with the synovial cavities has not been proven.

Plexuses of lymphatics, corresponding with the distribution of the bloodvessels, lie under the endothelium of the serous membranes. They are far more numerous under the visceral than under the parietal layer. These plexuses are in open communication with the serous cavities through the stomata. Klein[1] recognizes two kinds of stomata—stomata vera and stomata spuria. The stomata vera represent either the mouths of vertical lymphatic channels lined by endothelium and communicating directly with the lumen of straight lymphatic capillaries, or discontinuities between the endothelial cells of the surface leading into the superficial lymph sinuses. The pseudo-stomata[2] are the perpendicular processes of the branched cells projecting between the superficial endothelium, and represent the communication of the lymph-canalicular system with the free surface. Recklinghausen has demonstrated the connection of the lymphatics of the central tendon of the diaphragm with the peritoneal cavity. Dogiel and Schweigger-Seidel found similar openings. Dybkowski demonstrated them in the pleura, and Skwartzoff observed them on the cardiac surface of the pericardium.

Recklinghausen was the first to recognize the absorptive function of the lymphatics of the diaphragm. Ludwig and Schweigger-Seidel amplified these investigations, by tracing the lymphatics of the centrum tendineum of the rabbit to the lymphatic vessels which run between the tendon bundles, but it remained for Klein to trace the efferent trunks of those

[1] Anatomy of the Lymphatic System, p. 49.
[2] Loc. cit., pp. 53, 54.

distributed upon the outer and anterior portion of each anterior quadrant of the diaphragm, "along the pars costalis of the diaphragm, uniting on the posterior surface of the xiphoid cartilage on each side, in one or two larger vessels," which run along with the mammary vessels towards the sternal gland, "receiving along their course those lymphatics that come from the intercostal spaces." "The efferent trunk from the posterior quadrants is single on each side," and running towards the median line opens into the thoracic duct near where it emerges from the diaphragm. These efferent trunks communicate by anastomoses, and are formed of vessels having valves, which receive the superficial straight capillaries which lie in the pleural serosa and the deep straight capillaries which lie in the tendinous tissue of the diaphragm. Both kinds of straight capillaries communicate with each other at their crossings, the deep straight capillaries forming the vessels of communication between the superficial straight capillaries and the lymphatic trunks that lie in the pleural serosa. Ludwig and Schweigger-Seidel attribute to these straight lymphatics the function of absorption, and maintain that during the inspiratory position of the diaphragm they are widely dilated, whereas during the expiratory act they are compressed. Consequently, adds Klein, the respiratory movements of the diaphragm act like a pump on its lymphatics. The straight lymphatics constitute the vessels of communication between the efferent vessels of the anterior and posterior quadrants; thus the lymphatics of the diaphragm are discharged in two directions, one freely into the thoracic duct, the other less freely towards the sternal gland. Klein insists, furthermore, that the straight capillaries communicate freely, through the stomata, with the peritoneal cavity; consequently the mechanism represents a pump with two cylinders, acting simultaneously, "one corresponding to the pleural vessels of the anterior, the other to those of the posterior quadrants, while the pipe connecting the two cylinders is represented by the straight capillaries, and the piston tube by the vertical (stomata) lymphatic canals."

The lymphatics of the pleura pulmonis present a similar pump-like arrangement, the movements of which are consentaneous with the respiratory movements of the lungs. Klein (Anatomy of the Lymphatics of the Lung) has demonstrated a muscular coat of the pulmonary pleura, lying beneath the proper connective-tissue matrix, and arranged in bundles, with interfascicular meshes which communicate with the lymphatic vessels distributed on the pleural surface and with those running through the ligaments of the lungs towards the bronchial glands. Hence these spaces are in open continuity with the pleural cavity and with the lymph channels running towards the trunkal vessels. This muscular coat is found most abundant on those parts of the lung which participate most prominently in the respiratory movements. It must therefore follow that during expiration the contents of the meshes and vessels must be emptied towards the thoracic duct, and during inspiration they refill. The pleural lymphatics are intimately concerned in the absorption of effusions into the pleural cavity; in fact, it is only through these channels that the effused fluid can be returned to the blood vascular system. Hence the importance of preserving and restoring the normal movement of pulmonary expansion and contraction, to re-adjust, when disturbed, the regular movements of the pump-like action of the lymph-vessels, and thus to promote and expedite the process of absorption of pleural effusions. The utility of abstraction of the fluid by aspiration, in whole or in part, does not consist exclusively in the mere evacuation of the liquid, but also in the removal of the impediment to the free and regular expansion and contraction of the lungs, and in the restoration of the absorptive function of the pleural lymphatics. Thoracentesis is then not merely a surgical expedient to obviate impending suffocation, but a valuable adjuvant to the proper therapeutic management of cases of pleural effusion, and obviously should not be deferred until the cavity is replete with the accumulation. The absorptive function of the lymphatics of the peritoneum has also been frequently exhibited. This function is sometimes, in cases of excessive accumulations of ascitic fluid, entirely arrested, and can only be restored by the partial removal of the pressure by purgation or evacuation by paracentesis.

The lymph follicles consist of a reticulum formed into a close network, in the meshes of which are many nucleated corpuscles. They are very vascular; the blood capillaries being arranged in a wide meshed plexus. These follicles are found in the lower third of the tongue, in the tonsils (Curnow), the walls of the pharynx and œsophagus, the solitary glands of the stomach and intestines, and in the Peyerian patches; in the conjunctivæ, in the mucous membranes of the Eustachian tubes, larynx, trachea, and in the Malpighian bodies of the spleen, and substance of the thymus."

The lymphatic glands are small, solid bodies, varying in size from a hemp-seed to that of an almond, are of a round or oval form, and situated in the course of

the lymphatic and lacteal vessels. They are found in great numbers in the mesentery, in the mediastina, and along the larger bloodvessels in the abdomen. The variability in the structure of the lymphatic system is especially manifest in the glandular bodies.

The gland substance consists of a cortical and medullary portion. It is composed of follicular tissue, trabeculæ and lymph tracts. The trabeculæ are prolongations of the gland sheath, and continuous with the connective tissue of the hilus. In the peripheral portion they are more widely separated than in the central, and, in conjunction with the sheath, form alveolar-like spaces, uninvested, towards the hilus. As the centre is approached the trabeculæ approximate more closely, thus diminishing the invested spaces, and communicate more freely. The follicular tissue is usually formed into cord-like masses, and consists of a reticulum inclosing lymph corpuscles. The cortically situated portions are simply club-shaped dilatations of the medullary substance, differing from the latter in being more compact, with fewer and smaller lymph spaces. In the medullary substance the cells are densely packed, more distinctly fixed, and not easily washed out with the natural lymph current.

No doubt exists in regard to a channel of communication between the afferent and efferent vessels, though not by distinctly formed tubular vessels, but through a complex system of lymph paths, which communicate more directly and distinctly with the afferent than with the efferent vessels. The afferent vessels are distributed on the surface of the gland, and open into lymph sinuses, formed on the superficies of the alveolar trunks by the spaces between the follicular framework and the trabecular system. The rootlets of the vasa efferentia are moniliform, and communicate very freely, forming a cavernous structure, the separate vessels of which are very short and are supposed to connect with the lymph paths of the medullary substance. Recklinghausen describes the relations of the several parts, by supposing a "rete mirabile to be introduced between them, the several branches of which suddenly diverge from the extremity of the afferent vessel, and then proceed to divide and sub-divide, becoming consequently more attenuated. These finer branches perforate the intervening layers of tissue in all directions, freely anastomosing with one another, and finally suddenly reunite in the extremity of the continuous and tubular efferent vessel. The follicular substance is chiefly developed in the dilatations near the point at which the vasa efferentia are attached, and from this point becomes gradually more and more attenuated, till it loses itself on the lymph path at the borders of the medullary substance."

The bloodvessels, are, properly speaking, only distributed in the follicular cords; they alone contain any capillary network. The larger bloodvessels, proceeding from the trabeculæ, traverse the lymph spaces of the trabecular system, to reach the follicular masses.

An important anatomical characteristic of the lymphatic system is presented in the relation which the glands bear to the vessels. Every lymphatic vessel passes through a lymphatic gland, and many through two, before reaching the trunks. The lymph vessels, before penetrating the peripheric fascia of a gland, divide into a number of smaller vessels, which are distributed upon the surface of the cortical portion, and empty directly into the superficial lymph sinuses; and from each gland emerge a number of vessels, fewer in number but larger in size than the afferent vessels. The lymph is poured through the afferent vessels into the lymph spaces of the cortical alveoli, thence into the channels of the medullary substance, and escapes enriched in corpuscular elements into the efferent tubes. The current of a fluid passing through such a complex structure must necessarily be retarded. Soemmerring recognized the fact that the lesser number of efferent vessels, without aggregate increase of comparative calibre, did not compensate for the retardation of the current of the lymph in consequence of the obstruction presented by the structure of the glands. Thus, independently of the physiological function, the glands subserve an important office in regulating the flow of the lymph towards the central trunks; for as the system of lymphatic vessels is constantly diminishing in number and comparative capacity, until finally the whole is collected into two great trunks, it would follow that the impetus of an unimpeded current through unobstructed and lessened channels, would increase in a ratio proportionate to the pressure force of the accumulated fluid. The glands interrupt the continuity of the current, and consume or prevent this augmented velocity.

This relation of the glands to the lymph current is, moreover, especially interesting in its pathological significance. Whatever enters the lymph may, if small enough, pass through the gland and be swept along with the current; but the structure of the gland is, in a mechanical sense, a "filtering apparatus," interrupting the free current of the fluid, and retaining the coarser particles. The lymph, in passing through the gland, derives constituents which it did not previously possess, and the structure of the gland

which enables it to filter and retain certain elements subserves the purpose of protecting, at least for a time, the body from hurtful material, and may eventually convert it (Virchow) into a new source of infection. This fact is exemplified in the history of every malignant growth.

Perhaps the most interesting consideration connected with this relation of the lymph glands to the fluid passing through them is presented by the anatomical arrangement of the chyle vessels and the mesenteric glands. The lacteals, commencing as the central efferent vessels of the intestinal villi, pass between the folds of the mesentery, through several tiers of mesenteric glands, and, uniting into one or more trunks, terminate in the receptaculum chyli. Through these vessels the chyle flows. During digestion they are full of chyle, and during the intervals of digestion they convey lymph.

A thorough knowledge of the topographical anatomy of the lymphatic system is essential to fully comprehend the circulation of the lymph, and to understand the relation of the different parts to many diseases and injuries, but such a general description could not be properly introduced here. Only such references will be made, under their appropriate headings, as may be necessary.

Anomalies, Diseases, and Injuries of the Thoracic Duct.

Anomalies.—The thoracic duct is subject to many vices of formation. It may commence higher or lower in the abdomen, consist of one or more branches, divide at one or at several points between its origin and terminus, which divisions may again unite into a single trunk, or each branch may empty separately either into the left or right subclavian vein, or at some unusual point. Instances of very many and very remarkable deviations in structure, form, course, size, and termination, are to be found in the literature of the subject. Bartholinus, in 1686, and Walther, in 1731, recorded cases of bipartite ducts; Haller saw two instances; and Soemmerring twice found it completely double, in one case both terminating on the left side, one emptying into the jugular, and the other into the subclavian vein; in the other case a duct terminated on each side in the subclavian vein. Hewson describes a case where each branch possessed a separate entrance into the subclavian veins, and in the Monro anatomical collection is a specimen showing a division of the duct into two large branches, one ascending on each side of the aorta, and again uniting into a common trunk near the opening into the vein. Cruikshank refers to a similar case, and to instances of double and triple ducts, of transposition to the opposite side, and of various other irregularities in the course and connections of the main trunk. Wium, Heuermann, Velse, Pecquet, Lower, and Rolfinck have seen the duct terminate on the left side by two or three branches; and Otto refers to a wax model of a similar case in the anatomical museum at Upsal.

Of twenty-four cases examined by Verneuil, in three it had double, and in two triple terminations. Lachanchie reports a case of division into four branches, and Patruban saw two divisions form a ring around the subclavian vein. Verneuil saw it terminate by eight branches, two opening into the left subclavian, two into the right, two into the left jugular, one into the external jugular, and one into the vertebral vein. Albinus and Wutzer saw it terminate entirely in the vena azygos; and others have recorded cases in which branches were seen emptying into that vein. Otto has seen it thrust out of its place by exostosis, and, in a single case, by the inferior cava passing behind it and the aorta. Others have recorded instances of its displacement and occlusion by aneurismal and glandular tumors. Turner has reported two cases of complete obliteration of the duct, caused by the pressure of aneurism of the aorta; in one case the duct was wanting from the second to the fifth dorsal vertebra, and in the other case it was obliterated opposite the eighth dorsal vertebra. In neither case could an injection be forced past the points indicated. Morgagni quotes a case from Valsalva, and another from Santorini, in both of which the duct was occluded by an aortic aneurism. In Valsalva's case, the aorta, "from the heart to the diaphragm," was dilated into an enormous aneurism. Bennett and Laënnec each report a case. Narrowing or occlusion has also been caused by tuberculous and cancerous growths, by thrombi, by the pressure of tumors, and by cicatrices. Turner refers to a case in which was found in the "usual position of the thoracic duct a mere thread of cellular tissue, whilst on the left side of the aorta a duct passed upwards to the great veins on the left side." Sometimes the duct is greatly enlarged at its termination. Todd has observed several instances in which it was so considerable as to present the appearance of an aneurismal enlargement. Nuhn observed two instances where lymphatics opened into the renal veins, and a third where two large branches communicated with the vena cava inferior.

Matthew Baillie refers to an instance in which the thoracic duct was nearly as

large as the subclavian vein, "but nothing could be detected in the neighboring parts capable of accounting for it. There was no obstruction at the entrance of the duct into the venous system;" and, in a letter to John Hunter, communicating an account of a remarkable transposition of the viscera, he says, "the thoracic duct was seen in the middle between the descending aorta and vena azygos, in some places forming a plexus of several branches, in another dividing itself into two branches, which afterwards reunited in a common trunk, and at length climbing up to terminate in the angle behind the jugular and subclavian veins on the right side of the body."

Nélaton remarks that the thoracic duct, more frequently than any other part of the lymphatic system, is the seat of varicose dilatation, but Andral fils, in three hundred dissections, found it affected in only five cases. A number of such cases have been reported, but comparatively few in which the dilatation was unconnected with vices of texture. The very remarkable case of Amussat, in which the ectasis involved the thoracic duct even to its termination, was regarded by Carswell as a congenital malformation. Such was probably the nature of the following case of extraordinary enlargement of the thoracic duct, reported by Cruikshank. (See fig. 334.)

Fig. 334.

"The large duct will almost exceed belief. It is exactly, however, as found in the human body.

"It is seen *in situ*, with the more immediately surrounding parts.

"The spine is cleared by dissection and dried, in consequence of which the intervertebral substances are shrunk, perhaps to one-twelfth of their original thickness.

"The aorta, vena azygos, and lower portion of the left internal jugular vein, with that portion of the left subclavian vein which forms a right angle with it, are seen as half distended with coarse injection, and dried.

"The thoracic duct is seen under the same circumstances as little more than half distended with the injection.

"The man appeared to be forty years old. We know nothing of his history. There was no obstruction in the left jugular or subclavian veins, neither were they enlarged; there was no obstruction in the heart or lungs; no uncommon swelling in any of the neighboring parts compressed the duct. The great trunks of the absorbents accompanying the large arteries in the extremities were, in proportion, large, but the cutaneous absorbents were not larger than usual."

Cruikshank states that he had seen the thoracic duct "as large as the carotid artery of an adult, or the barrel of an ordinary writing pen," and also refers to a preparation in the collection in Windmill Street, "in which an injection thrown into the umbilical vein of a child passed directly into the thoracic duct."

Vices of texture, in the lymphatic system, are not unlike those found in the veins, and a number of cases have been recorded in which the thoracic duct was found diseased.

Diseases of the Thoracic Duct.

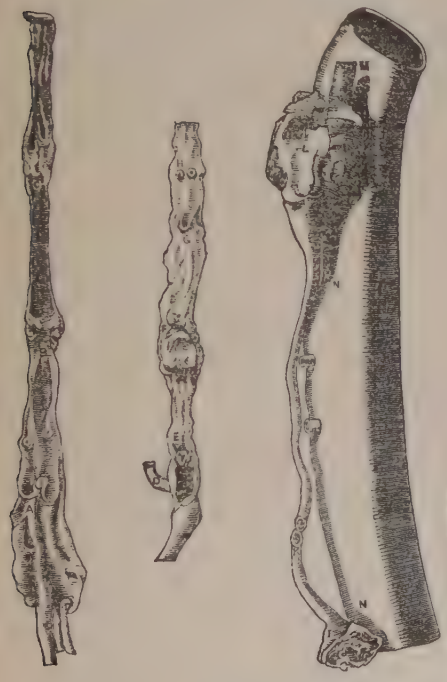
In 1789, Cooper observed in the cadaver of a person, believed to have died of phthisis pulmonalis, the thoracic duct completely occluded at three points (A, B, and C, fig. 335) by thickening and immobility of the valves. In a second case, he found the duct occluded at two points by fungous growths (E and F, fig. 336). In this case the chyle was conveyed by an anastomosing branch (D) which passed above the obstructions and terminated in the thoracic duct.

The following case, also reported by Cooper, illustrates the pathological connection of disease of the duct with disease beginning in remote parts of the lym-

phatic system, and the conservative effort of nature to avert danger, by the establishment of anastomotic connections with the venous system.

"A laboring man, aged 22, was admitted to the hospital January, 1795, with enlarged testicle, abdominal tumor, and enlarged absorbent vessels and glands. The swelling of the testis began five months, and the abdominal tumor, situated to the right of the navel, was observed seven weeks, prior to his admission. At this time the testis had attained considerable size, but preserved its natural figure, being flattened on its sides, and round on its forepart; it felt pulpy, yet not fluctuating; the spermatic cord was somewhat enlarged. The tumor in the abdomen, small when first observed, was now four inches in diameter, and occasioned very considerable pain. His general health was good.

Fig. 335. Fig. 336. Fig. 337.



"Two weeks after admission he complained of great pain in the abdomen, extending in a line from the testis to the tumor, and lost strength very rapidly. His pulse became quick and feeble; he had continued thirst; great restlessness; his appetite failed; and his bowels became irregular, sometimes costive, at others very loose; he suffered from distension in the upper part of the abdomen, after taking a small quantity of food, which continued for several hours.

"The patient continued to grow worse; the pain increased in intensity, extended from the tumor to the testis, along the spermatic cord and down the thigh. Exhausted by vomiting and diarrhœa, he died Feb. 14, 1795."

Autopsy.—The testis was a "a pulpy mass, composed of broken-down coagulable lymph and of a blood-colored serum.

"The absorbents of the spermatic cord were considerably enlarged; their coats thickened; valves diseased, impervious, and containing matter similar to that found in the testis, which adhered firmly to their internal coats.

"The small glands in the loins, which receive the absorbents of the testis and cord, by their enlargement and union, formed a tumor on the lumbar vertebræ, weighing nine and a half pounds. This tumor forced the duodenum and pancreas forward, and compressed them between it and the abdominal parietes. The tumor exhibited a similar appearance to the testis.

"The thoracic duct was much altered; its coats were thickened and opaque, and it was much rounder than usual, bearing more resemblance to a nerve than to the principal trunk of the absorbent system. The receptaculum chyli was filled with matter of the same kind as that found in the tumor, in the absorbents of the spermatic cord, and in the body of the testis. . . . The thoracic duct had undergone a similar change, and was impervious (see K, fig. 337). Opposite the curvature of the aorta the duct was lost in a large swelling (L), which differed only in bulk from the abdominal tumor." (Fig. 337—J, receptaculum chyli; K, thoracic duct; M, the duct emerging from the tumor; N, aorta.)

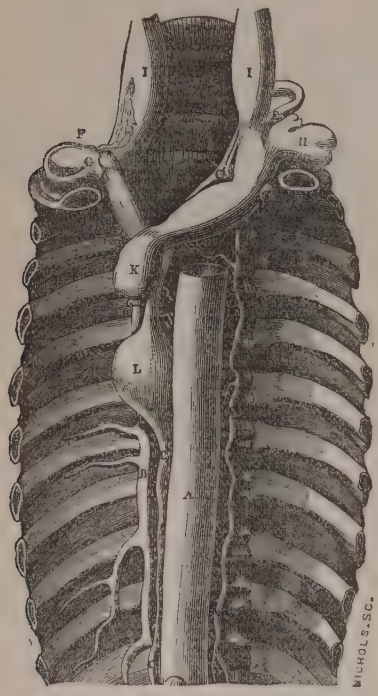
Cooper expresses the opinion that the disease was cancerous. To ascertain the course of the chyle, he injected mercury into an absorbent of the loins, which passed as far as the receptaculum, then "ran through several vessels behind the aorta into a large trunk (K) which passed the whole length of the chest on the left side of the spine," to the first dorsal vertebra and then entered the thoracic duct above the tumor.

Cooper supplies the following illustration (fig. 338), showing an obstruction of the thoracic duct by disease (L), and the formation of a new duct (N) which communicated with the proper duct (at O), thus restoring the connection between the receptaculum and the subclavian vein.

M. Andral fils found, in the body of a phthisical patient, the thoracic duct from the diaphragm up to the body of the fifth dorsal vertebra dilated into a sac and filled with pus. That portion corresponding with the bodies of the third, fourth, and fifth vertebræ was transformed into a fibrous cord. The communication was preserved by an anastomosing branch similar to that represented in fig. 336. In another case, after death from chronic nephritis, he found the thoracic portion of the duct filled with pus, with inflammation of its coats. The right kidney was

"transformed into many pouches filled with pus." In a boy of 11, who had died of croup, with pleuro-pneumonia and gastritis, he found the walls of the duct thickened and more friable than normal; the lumen contained but little transparent serum—its lining membrane was markedly inflamed. The glands along the duct and those about the receptaculum were tuberculous. He has also reported the case of a woman who died of abscess in the broad ligament and peritonitis, in which he found vessels communicating with the duct, filled with pus, and in another instance the canal was distended with a "white, friable, concrete substance, resembling tuberculous matter." In a sixth case he observed the duct enlarged to the size of a "writing-pen" from the pillars of the diaphragm to its outlet, and distended with a purulent fluid. In the latter case the intima was red, thickened, and easily detached. Abscesses in the broad ligament and iliac fossæ were also present.

Fig. 338.



A, aorta. *B*, vena azygos. *C*, thoracic duct. *F*, right absorbent trunk. *G*, right subclavian vein. *H*, left subclavian vein. *I, I*, jugular veins. *K*, superior cava. *L*, tumor on duct. *N*, new thoracic duct. *O*, entrance of new duct into the duct proper.

Gendrin saw, in a woman who had died of peritonitis, the receptaculum chyli distended "with white, consistent pus." Its walls were red and friable. The thoracic canal throughout its entire course contained pus, and its internal surface was studded with plastic concretions adherent to its wall.

Velpeau found pus in the duct of a woman who had died of puerperal fever, with abscess in the ovary and broad ligament.

Cruveilhier and Andral report cases in which cancerous matter and pus were found in the thoracic canal in cases of uterine sarcoma. Tonellé records a case of puerperal metritis in which the lymphatics of the abdomen were distended and of a milky color; the thoracic duct was enlarged and filled with pus. Joseph Lieutard reports a case in which the duct and receptaculum were gangrenous.

Graves and Stokes report the case of Anne Norris, who was seized with a rigor, followed by fever for several days, accompanied with a painful swelling in the left iliac fossa, which was mistaken for fecal accumulation. After several days the fever subsided, and she returned to her usual occupation, but was again seized with a rigor, followed by pains in the trunk, extremities, and lumbar region. The tumor was more painful and enlarged. She died on the second day after admission to the hospital.

"*Autopsy.*—Not emaciated. Sigmoid flexure displaced by the tumor, which was caused by an abscess in the psoas muscle, extending from below Poupart's ligament to the last dorsal vertebra. The abscess contained healthy pus. The internal sac was quite smooth, and exhibited towards its inferior-posterior portion five or six orifices of the diameter of peas, funnel-shaped, and connected with the sac. They terminated in organized tubes, which led to a mass of diseased glands that lay on the brim of the pelvis. . . . The vessels between the glands and the abscess were filled with pus, and the glands were distended with matter, in some, still fluid, but thicker than pus; in many it was converted into a soft, cheesy mass. From these glands ascended a chain of lymphatics communicating with the thoracic duct, and containing solid matter resembling tubercles. The thoracic duct was distended to the size of the middle finger, felt hard and nodulated, and contained similar matter, harder, and mixed with a large proportion of a calcareous substance. The uterus was filled with caseous matter; the other abdominal and thoracic viscera healthy."

Worms reports a case of inflammation of the thoracic duct in a man aged 48, whose health had been broken by arduous military service. After a chill, with sore throat and fever, he was seized with violent pain deep in the belly, which radiated to the sides, accompanied by malaise, sleeplessness, and high fever. These symptoms moderated, and were followed by acute pains in the muscles of the left forearm, thighs, and calves. Power was completely lost in the left arm. The abdominal pains recurred with augmented intensity; his face denoted great suffering; complexion became icteric; tongue coated; and sordes collected about the teeth. Skin was dry; pulse hard, not above 80; scleroticæ became yellow; belly tense and tympanitic, but painless on pressure. Intelligence remained unimpaired. Circumscribed swellings formed on the posterior surface of the left arm and on the forearm, and the superficial veins became distended, painful,

and felt like cords; the blood could not be pressed out of them towards the heart. The left subclavian vein, in its axillary extremity, became hard and rolled under the finger like a cord.

"*Autopsy.*—Whole body, except left arm, intensely yellow. Veins of the left arm distended, surface ecchymotic, skin thickened, aponeurosis thickened, but no pus in its meshes. All the tissues of the arm stained deeply yellow. Blood in the veins viscid, decolorized, looking like bile. The lumen of the cephalic and basilic veins irregularly filled; at some places empty. The left subclavian was doubled in size, and completely obstructed at its junction with the internal jugular with a yellow, hard, slightly adherent, organized mass, which extended six centimetres toward the axilla, and sent a prolongation into the jugular. The veins from the junction to the heart were filled with partially clotted blood, and a fibrinous clot occupied the cavities of the right auricle and ventricle, which also extended for some distance into the pulmonary artery. Heart normal; lungs congested inferiorly and posteriorly. Solitary intestinal glands deeply ulcerated; spleen enlarged, softened; liver normal; portal vein filled with blood. Thoracic duct obliterated at its outlet by a mass pressing upon its descending portion. The remaining portion was dilated to the size of a crow's quill, and gorged with pus. Its walls were thickened and opaque; the internal surface softened, velvety, ecchymotic, and without epithelium. Receptaculum enlarged, filled with pus; its walls were in a condition similar to those of the duct. Mesenteric glands enlarged. Supra-renal capsules disorganized, and seeming to be connected with the reservoir of Pecquet by lymphatics, filled with a purulent fluid."

It is impossible to adopt any exclusive view in regard to the primary or secondary nature of diseases of the duct. It is obvious that diseases may originate in the tissues composing its walls, but the similarity of the morbid processes found in the duct with the degenerative changes found in other parts, indicate their secondary nature; and, as in the case of Graves and Stokes, in which the dilated vessel was filled with morbid material identical in character with that found in ectatic vessels directly connecting it with the original seat of disease, it must be conceded that lesions of the duct may and do succeed to diseases of remote parts of the lymphatic system. Among the cases previously referred to, the diseased duct was associated with tuberculous degeneration of the lungs and mesenteric glands, with gangrene of the lungs and abdominal viscera, with suppuration of a chain of cervical glands, with abscess in the kidneys and lumbar glands, and with cancer of the testis. In all the cases the lymphatic system was chiefly involved; in some by extension from one part to another by continuity; in others by conveyance of infective material through anastomosing vessels, or extension from diseased glands in close proximity. The duration of the abscess in the case of Anne Norris could not be determined, though it is probable it had commenced long anterior to her admission to the hospital, yet it was unattended by emaciation, hectic fever or marked constitutional suffering. The abscess communicated through the lymph vessels with the duct, and it is probable this communication had been effected gradually, but that suddenly a copious discharge of pus had taken place through the channels, filling the duct and producing death. The extraordinary dilatation of the duct, and its knotted and nodulated condition, indicate a gradual process of disease, but the remarkable exemption from the usual subjective symptoms attending such large collections of pus, illustrates the comparative freedom from hectic and constitutional symptoms, when such sacs of pus are confined to lymphatic structures. The idiopathic nature of the inflammatory process observed by Worms in the walls of the duct is rendered doubtful by the condition of several efferent vessels, which appeared to be connected with the disorganized supra-renal capsules. Most of these cases exhibit the marked tendency of diseases of the lymphatic system to morbid processes of a destructive nature, enfeebling the constitution, and promoting rapid waste. Occasionally, however, adhesive inflammation is set up. In Andral's case a portion of the duct "was transformed into a sort of fibrous cord," and this condition was found in a patient who had died of phthisis. The duct has also been observed obstructed or obliterated by organized lymph.

Besides blood, pus, bile, ichor, and other extraneous substances, calcareous material has been found in sufficient quantity to completely fill the duct.

Lieutard found in the body of a scrofulous subject the mesenteric glands and thoracic duct filled with a chalky material.

Cheston has (see fig. 339) reported a case of "ossification of the thoracic duct," in which the pelvis was filled with a "confused mass composed of scirrhus, cartilage, bone, and stone." The duct and receptaculum were completely plugged with ossific matter. Assalini found the duct obstructed by earthy or osseous material. Andral saw in a woman who had died of acute pleuritis, supervening upon a chronic pulmonary affection, in whom the bodies of the last dorsal and five lumbar vertebræ had been destroyed, calcareous concretions in the cervical, thoracic, bronchial, abdominal, pelvic, axillary, and inguinal glands; and, in another case, in which an

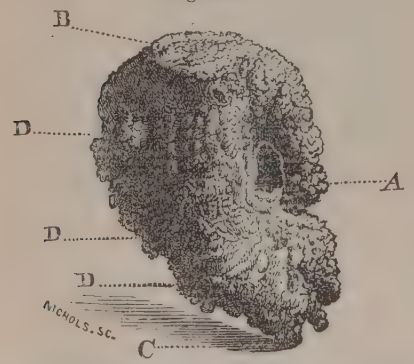
os ilii was destroyed, he found calcareous concretions in the lungs, and in the bronchial, pelvic, and mesenteric glands. Wrisberg and Mascagni report cases of calcification of the walls of the duct.

Fig. 339.

a. Receptaculum chyli laid open to show substance within. *b*. Opening into thoracic duct to show the manner in which it was blocked up. *c*. Lymphatic gland containing a similar substance to that found in receptaculum. *d*. Coats of duct separated from the bony matter. *e*. Vena azygos.

In several cases calcareous concretions have been found in the receptaculum, in connection with similar depositions in other parts of

Fig. 340.



A. Large foramen in calculus. *B*. Several openings, permitting the passage of a bristle. *C*. Centre of calculus. *D*. Various prominences obstructing the lymphatic vessels.

the lymphatic apparatus; but in the case reported by Johann Georg Scherb, the deposit was only found in the receptaculum (see fig. 340).

Wounds of the Thoracic Duct.

But few cases of wound of the thoracic duct have been reported, and most of them are doubtful. Monro, who wrote in 1765, quotes the cases of Bassius and Morton, and also a third case. In the case of Bassius "an orifice from which the chylous matter flowed as from a fountain," was discovered in the body of a man who had died "after a large quantity of chylous liquor had been let out of his thorax." In Morton's case the rupture of the lacteals had been occasioned by the compression of the duct near the subclavian vein, by a number of indurated tumors. The third case was that of a girl, who became hydropic "after too great an effort to raise a burthen." From the frequent tappings there always issued "a chylous fluid, not unlike milk in color, taste and consistency." Bartholini mentions a case in which the duct was wounded, and the patient lived a long time. Goodlad refers to the case of a woman who was wounded in the duct, "at least the mucus and liquid that came out of the wound made it appear so; the patient was nearly cured, but after an excess relapsed and died." The case of the learned mathematician and theologian, reported by Hoffmann, was undoubtedly a case of empyema, and the case of the Baron de Heinden, reported by Bonet, was simply a suppurating wound. None of the foregoing cases can be properly classified as wounds of the thoracic duct. There are, however, several cases which must be accepted as authentic. Hoffmann relates the case of a woman who was wounded in the left side by a knife. From the wound a spontaneously coagulating fluid escaped, which was milky during digestion, and clear when the patient was fasting. Monro reports a case in which lymph escaped externally through a wound caused by a stab, and also into the pleural cavity. The case of Guiffart was somewhat similar. Quincke reports the following case of effusion of chyle into the right pleural cavity.

C. S., æt. 50, male, dissipated; previous health good. Was run over by a wagon whilst lying partly upon the right side and abdomen. Eleven days afterwards he was admitted to hospital on account of pleuritic effusion. Superficial lesions and bruises healing. Seventh and ninth ribs broken anteriorly in the axillary line. Dyspnœa set in on the third day after the accident, and increased from day to day until the tenth day after admission, when 1800 cm. of fluid were withdrawn. The fluid was of a whitish yellow color, had the appearance of milk, and after standing, presented upon its surface a white layer of cream of the thickness of a

millimetre. It exhibited under the microscope minute fat-globules. Subsequently, after the disappearance of all the symptoms of the hydro-pneumothorax, œdema supervened, radiating from the puncture, and extending over the entire right side of the trunk and to the middle of the thigh. After puncture a milky fluid flowed guttatim from the œdematous part, at the rate of 100 cm. per hour. The fluid reaccumulated in the pleural cavity, and during the third tapping the patient expired.

Sectio cadaveris, by Prof. Langhans. "Upon right side of thorax moderate infiltration of cellular tissue and muscles, with nearly clear fluid. Diaphragm of left side as high as fifth intercostal space; of right side convexed and bulging downward. Right pleural cavity contained 7000 cm. of a milky, whitish-yellow fluid; pleura transparent; no injection anywhere; no discoloration or thickening. Towards the mediastinum milk-white deposits, easily removed; most copious upon the upper portion and at the apex of the pleural cavity. Subpleural cellular tissue at sternal end of first rib and the adjacent part of sternum contained a white, milky fluid, but no lesion of the pleura could be found in that region. This limited extravasation did not extend to the thoracic duct. The duct, from its mouth to the point of emergence from behind right subclavian, was filled with coagulated blood. The lower portion could not be dissected out. Left pleural cavity contained 100 cm. of nearly clear serous fluid. Sixth, seventh, and eighth left ribs broken in axillary line. Right lung compressed, atelectatic, without other changes; ribbon-like adhesions with lateral thoracic walls. Heart, liver, and kidneys normal. In spleen small, coagulated, hemorrhagic spots. Mesentery and mucous membrane of intestines without chyle. In pelvic cavity and between intestinal convolutions a small quantity of a whitish fluid. Chemical examination of fluid proved it to be animal chyle."

Lower ruptured the thoracic duct of a dog by introducing his finger between the ribs. The animal died after languishing a few days, and two pounds of chylous fluid were found in the right cavity of the thorax. Monro inflicted a wound in the receptaculum chyli of a pig, which was cured in a very short time. The effusion of lymph was prevented by a coagulum.

Rupture of the Thoracic Duct, Receptaculum Chyli, and Lacteals.

Clinical as well as experimental observations have shown that rupture has occurred most frequently in the receptaculum, and least often in the duct. In Sir Astley Cooper's experiments, the rupture took place in the receptaculum. Dupuytren's experiments were attended with like results. Morton performed a number of ligations of the duct upon dogs; in some instances the receptaculum, and in others, "the larger lacteals burst."

There is no instance of the preservation of the life of the animals beyond a limited number of days, in which the communication of the chyle-conveying channels with the venous system had been completely and permanently obliterated. In the experimental cases the wound necessary to secure the thoracic duct could not have caused the speedy death of the animals, for in a number of cases it healed by first intention; neither could death be attributed to rupture, either of the thoracic duct, the lacteals or receptaculum, nor to the extravasation of chyle or lymph into the pleural or abdominal cavities, or into the cellular tissue about the abdominal viscera, for death took place in those cases in which neither of these results complicated the ligation of the duct, as it did in those in which one or more of these conditions supervened. In the animals upon which Dupuytren experimented, and which survived, injections could always be passed from the duct below the ligature into the subclavian vein through anastomosing branches; in those that died no such connection could be established. But one of the animals, in which Flandrin ligated the duct, died; but he failed to determine the existence or non-existence of anastomosing connections. Duverney's, Lower's, and Morton's experiments indicate the certainty of death after the ligation of the thoracic duct, unless the communication with the venous system should be preserved or re-established through anastomoses. Leuret and Lassaigne tied the thoracic duct of a dog, which, under treatment, was restored in fifty-eight days to a fair condition. The animal was killed during digestion, and upon dissection the duct was found single, and the lacteals and receptaculum contained a small quantity of chyle; but they neglected to eliminate the doubt in regard to the existence of another channel of communication by attempting injection. In Cooper's fourth experiment, in which the animal recovered, it was established by dissection, that the incompletely interrupted communication had been restored by the dilatation of an anastomosing connection.

The clinical and post-mortem observations, in which the communication between the venous and lymphatic systems was either partially obstructed or wholly obliterated, are not very numerous, and many of the reports are simple statements of bare facts, unaccompanied with the clinical histories of the cases, and are wanting in the particulars essential to the deduction of clear and decisive conclusions in regard to the agency of the, at

least partially, obstructed condition of the lacteals and of the thoracic duct in causing death. The grouping together, however, of these isolated observations is peculiarly instructive, not so much in pointing so directly, as the experimental observations, to the interruption of the communication as the immediate and only cause of death, as in affirming and strengthening that view and in elucidating the manner in which the inevitable result is produced.

Soemmerring found, in several instances, the lacteals filled with a cheesy material; and Walter found them similarly obstructed, and associated with indurated mesenteric glands, in a man 30 years old.—Sandifort has depicted the lacteals enormously swelled, in an infant a few days old.—Ludwig found them in a similar condition, associated with scirrhous mesenteric glands, in a girl seven years old.—Assalini found the thoracic duct obstructed by an earthy or osseous material; and Bayford observed the cavity of the thoracic duct narrowed by the pressure of an aneurism.—Watson found the duct obstructed in a case of incurable marasmus.—Lieutard found in the body of a patient who died of consumption the thoracic duct three times its normal size and full of chalky material.—Bassius found an orifice in the thoracic duct in a man from whose thorax "a large quantity of chylous liquor" had been evacuated.—In Morton's case the thoracic duct was occluded by the pressure of indurated tumors, and the lacteals were found ruptured.—Cheston found the thoracic duct entirely occluded with ossific matter, from immediately above the receptaculum chyli up to the curvature of the aorta. Air could be forced between the walls of the receptaculum and the adventitious product within it, but Mr. Cruikshank failed to force mercury through the duct. This case was admitted to the hospital June 5, 1779, complaining of rheumatic pains, soon followed by swelling of the right thigh, and died October 10. Death was preceded by languor, loss of strength, and insensibility.—Cooper found in a cadaver, which presented the appearance of a person having died of phthisis pulmonalis, the thoracic duct so obstructed at several points by diseased valves that mercury could not be forced through the lumen; and in a second case, in assisting Mr. Waterworth to make a preparation of the thoracic duct, failed to force the mercury any further than the fifth dorsal vertebra, but discovered an anastomosing connection with the venous system.—In the case of John Hammett, who was admitted to the hospital in January, 1795, and died February 14, 1795, Cooper found the receptaculum and the thoracic duct filled with a pulpy mass, the latter being, for some distance, impervious. Mercury injected into an absorbent of the loins passed as far as the receptaculum, and then ran through several vessels behind the aorta, connecting with the duct proper above the obstruction. This patient, when admitted, was suffering from a diseased testicle and an abdominal tumor, which in two weeks were followed by a loss of former florid aspect, sudden debility, great thirst, loss of appetite, disordered bowels, and a sense of distension in the upper part of the abdomen after taking even a small quantity of food.—Scherb found the receptaculum filled with a calculus, and entire obliteration of a portion of the thoracic duct, in a man who had died from dropsy. Through a foramen in the calculus the thinner portion of the chyle passed, and life was preserved for a time.—Graves and Stokes found the thoracic duct greatly enlarged and filled with cheesy and calcareous materials, in a patient who died of psoas abscess, which communicated through the lymphatic vessels with lymphatic glands and with the thoracic duct. The patient died suddenly the day after, having been bled to ten ounces; was not emaciated, and had not suffered from hectic. Chyle flowed through the duct, but mingled with the purulent contents.—Andral found the thoracic canal obliterated in the body of a phthisical patient, but the chyle flowed through a small anastomosing branch.—The case of chylous ascites reported by Poncy is peculiarly instructive. From July 16, 1699, to March 4, 1700, the date of death, 289 French pints of fluid had been drawn in 22 tappings from the abdominal cavity. The evacuated fluid was always chylous, and frequently exhibited the unmistakable odor of articles of diet which had been previously ingested, thus conclusively demonstrating that digestion had taken place, and that the product of such digestion had poured into the peritoneal cavity through the ruptured lacteals; and that the progressive emaciation and waste exhibited in all the tissues and in every part of the body had resulted from the loss of this nutrient material through the ruptured orifices and its frequent evacuations through the abdominal walls.—Quincke's case of effusion of chyle into the peritoneal cavity died of asthenia.

Meagre and unsatisfactory as these clinical details are, they nevertheless point distinctly to two conclusions: 1st. That a free and unobstructed channel of communication between the venous and lymphatic systems is essential to the proper nutrition of the body and to the preservation of life. So manifest is this conclusion, deducible alike from the experimental, traumatic, clinical, and post-mortem observations, that it must henceforward be accepted as a fact. 2d. That death following the partial or complete obliteration of the communication is the result of inanition. The gradual wasting of the body and progressive debility, which so markedly characterized the clinical cases in which the flow of chyle through the thoracic duct or through anastomosing connections was insufficient for the maintenance of the normal standard of nutrition, more decisively points to inanition as the cause of death, than the sudden exhaustion which preceded the death

supervening upon the abrupt arrest of the current of chyle and lymph towards the blood. Investigators are not agreed as to the cause of the speedy death which invariably follows artificial obliteration of the communication. In the experimental and traumatic cases, there may have been a superadded element of violence, but that this element can find a satisfactory explanation in the consequent distension and occasional rupture of some of the chyliferous vessels, is controverted by those clinical observations in which life, associated with progressive wasting and increasing exhaustion, was preserved for a variable period notwithstanding that there was a continuous loss of chyle through ruptured vessels; and, furthermore, by the fact, established by the experiments, that in every instance of artificial obliteration of the communication in which death occurred, no anastomosing connection could be recognized, and in every case in which life was preserved, where proper measures were adopted to eliminate all doubt, such anastomosing connections were discovered.

Clinical records furnish a number of cases which illustrate the direct relation, as cause and effect, which subsists between copious losses of lymph and chyle and the marked depression, dulness and exhaustion, which invariably succeed abundant lymphorrhagia, and which likewise abruptly follow artificial occlusion of the thoracic duct, and so distinctly characterize the brief after-life of the animal thus permanently deprived of the material necessary for the sustenance of the body and for the maintenance of the functions of animal life. With a single exception (Demarquay's case), every instance of copious loss of lymph, whether through the rupture of a lymphatic vessel or by transudation, has been attended with the manifest evidences of great prostration.

The cases of experimental and permanent obliteration of the connection of the lymphatic and venous systems, and the cases in which excessive loss of lymph has occurred through rupture of some distended lymph vessel, though analogous in symptomatic phenomena, varying, it is true, in intensity according as the case may have been one of complete deprivation, or one of copious lymphorrhagia, differ very materially in termination. One class ends in speedy death, the other, by rest, suspension of the loss of fluid, and proper alimentation, soon recovers wonted health and vigor, to suffer again, and, perhaps, many recurrences similar in course, duration, and effects. This widely variant result, which in one class of cases associates death directly with the complete and permanent deprivation of the blood of the nutrient fluid; and in the other class associates recovery with the opportunity to replenish loss, and thus to restore health and prolong life, fastens attention to the circumstance that as the latter class is characterized by the unmistakable evidences of prostration, so death in the former class must be regarded as the ultimate termination of a similar condition passed beyond the resources of art and science.

The mode of death may not be by starvation, as implied in the ordinary acceptation of the word, but, assuredly, it is by exhaustion from want of nourishment—acute impoverishment of the blood—inanition, a pathological condition, not representing a physiological waste of material necessary for the regeneration of the blood, renewal of the tissues, and for the normal maintenance of the vital and physical forces. Lower concluded from his series of experiments, that every wound of the thoracic duct must be followed by death from starvation.

Effusion of Chyle into the Pleural and Peritoneal Cavities.

There have been, including the doubtful cases of wounds of the thoracic duct, reports of ten cases of lesions, produced either by disease or accident, either in the duct or some of its larger branches, in or about the thorax, sufficient to allow the escape of fluid in quantities incompatible with a vigorous health, and certainly endangering life, if not causing death. In five of these cases chyle poured directly from the duct; in one the aperture was only discovered after death, and in the others the rupture was the result of external violence.

In Curling's case a lymph concretion which occupied the right pleural cavity was discovered in the body of a patient whose right lower extremity had been amputated at the hip-joint two months prior to death, for malignant disease of the hip.—In Rokitansky's and Ormerod's cases the chylous fluid was effused into the pleural and peritoneal cavities; in the former in consequence of obstructed heart circulation, and in the latter as the result of the interruption of the blood-current in the left subclavian vein.—In the two cases reported by Quincke, there was found chylous fluid in the pleural and peritoneal cavities; but the post-mortem examinations determined the cases, one as of effusion into the pleural cavity, the other as chylous ascites. In both cases the anatomical lesions were clearly made out; in one, laceration of the duct permitted the escape of chyle into the pleural cavity, and in the other chyle-retention was caused by an inflammatory thickening of both folds of the mesentery, by which the lacteals were narrowed or completely occluded. The flow of chyle was ob-

structed, engorgement of the lacteals occurred, rupture followed, and the fluid poured into the peritoneal cavity. In several of the cases the chylous fluid was present in both the pleural and peritoneal cavities. This phenomenon is, perhaps, partially explicable, upon the supposition that portions of the effused fluid traversed the lymph vessels of the diaphragm.

Of the twenty-seven cases of chylous ascites, in two the orifice through which the fluid was discharged was found in the walls of the receptaculum chyli; in one the rupture occured in consequence of stenosis of the thoracic duct near its outlet, and in the other from ossification of the wall of the receptaculum and filling of its cavity with "bony concretions."—In five cases, and probably in two others, the rupture took place in the chyle vessels of the mesentery. In four of these cases, and in the cases of Abell, Hoppe-Seyler, and Wilhelm, in which no post-mortem examination was had, abdominal tumors were discovered, either by inspection of the cadavers or by palpation during life, and the probability is that the rupture was the result of compression, either of the thoracic duct, which in some of the cases was very much dilated, or of the lacteal vessels.—In two other instances the duct was compressed by tumors situated in the thorax near its entrance into the left subclavian vein. These tumors were usually glandular, and consisted of hypertrophied and degenerated lymph or mesenteric glands, co-existing in two cases with an enlarged liver, and in two other instances with cancerous formations.—In one case there was chronic peritonitis with an enormous amount of fat in the effusion, fatty degeneration of the liver, free fat in the blood, and fatty contents of both ovaries, combined with hair and bony matter.—In one case the milky fluid was found in the abdominal cavity of the cadaver of a puerperal woman.—In one case Prof. Winiwarter ascribes the intra-abdominal chylous effusion "to congenital occlusion of the thoracic duct, formation of a compound cystic tumor through distension of the lacteals at the root of the mesentery by obstructed chyle, rupture of one of the cysts before or during birth, persistence of this solution of continuity, and increasing effusion of chyle absorbed by the intestines."—In a single instance the ascites was ascribed to the presence of a parasite in the lymph vessels, which was first discovered by Lewis in his investigations into the nature and cause of chyluria, and which he believes penetrates the walls of lymph-vessels, thus establishing apertures through which the contents are discharged into the bladder in cases of chyluria, and as is supposed to have occurred in Winckel's case, into the peritoneal cavity in cases of chylous ascites. It is not, however, necessary to assume the presence of the *filaria* in the cases of chylous ascites previously cited; for in all of them, excepting the cases of Monro and Winckel, conditions were present which satisfactorily explain the cause of the effusion of a chylous fluid. It is, nevertheless, worthy of notice that in Winckel's case, in which the "filiform entozoa" were discovered, there was a co-existing condition of the left lower extremity similar to phlegmasia alba dolens, and in Quincke's case of peritoneal dropsy, in which the chyle retention was satisfactorily accounted for by the condition of the mesentery, there was also present an œdematous condition of the right leg and forearm, and elephantiatic formation, which was, presumably, due to disturbances of the lymphatic circulation of the parts thus affected.—In several cases the chylous ascites was ascribed to obstructed pulmonary circulation, in others to interrupted cardiac circulation, and in another class of cases to obstructed chyle-current in consequence of stenosis of the thoracic duct at or near its junction with the left subclavian vein.—In Stewart's case, in which the discharge of chyle from the thoracic duct was interrupted, distension of the lacteals ensued.—In Rokitansky's case, in which a similar obstacle existed, dilatation of the thoracic duct and chyle-vessels followed. In the cases in which a chylous fluid was extravasated into the peritoneal cavity, rupture of the lacteals occurred. In Poncy's case, in consequence of impenetrable mesenteric glands; in Hughes' case, because of the degeneration of mesenteric glands and the pressure of a tumor.—In Morton's case it was occasioned by the compression of the thoracic duct near its outlet; in Perceval's, by violence; and in Quincke's, by inflammatory thickening of the folds of the mesentery.—In Cayley's the mouth of the thoracic duct was narrowed by a fibrinous vegetation in the subclavian vein, and rupture of the receptaculum followed the sudden blocking up of the opening of the duct by a clot.—In Ormerod's, in which the chylous fluid found exit into the peritoneal cavity through ruptured lacteals, the left subclavian vein and its affluent vessels were plugged with a clot.—Virchow saw "in a new-born calf the mouth of the thoracic duct closed by a congenital thrombosis of the jugular vein. In this case nearly all the organs were distended to the utmost by dilated lymph-vessels; the intestines especially were covered everywhere so thickly by broad bead-like bands, that interstitial tissue could hardly be recognized."—In Petter's case, in which there was stenosis of both auriculo-ventricular orifices, and dilatation of the right side of the heart, the lymph-glands of the right inguinal region were transformed into cysts, and the mucous surface of the intestines was covered with lenticular eminences filled with a transparent fluid.—There are a number of other cases in which dilatation and rupture of lymph-channels occurred in consequence of impediment to the lymph-stream, located at or near the junction of the thoracic duct with the left subclavian vein; but the case of Virchow, probably, also, that of Friedberg, and that of Cholmely, are the only instances of lymph varices caused by congenital heart anomaly.

The milk-like fluid found effused into serous cavities must be classed, according

to its pathological aspects, into a chyle-like and a fatty fluid. Much the larger number of the cases of chyle-like effusions into the peritoneal and pleural cavities were due to the escape of the contents of chyle-conveying vessels. In the exceptional cases it is equally manifest that the milk-like fluid was directly connected with the co-existing degenerative process.

Quincke has reported two cases of adipose or fatty dropsy connected with peritoneal and mesenteric cancer. Analogous cases have been reported by Friedreich, Klebs, and others. Bergeret's case of "oily ascites," was associated with suppurating lymphatic glands. In Hughes' case, "cerebriform cancer" was present; and in Quincke's case of effusion of chyle into the peritoneal cavity, a cancerous nodule developed in the subcutaneous cellular tissue at the point of puncture. In several of the cases of fatty ascites, tumors were distinctly recognized in the abdominal cavity; in a few instances supposed to be enlarged mesenteric glands, but in the absence of an autopsy, the nature of the glandular affection could not be determined. In two or more cases, pulmonary tuberculosis was present. The presumption is, that in those cases of adipose ascites or fatty accumulations in the pleural cavity, which were associated with cancerous or tuberculous processes, the serous membranes were either primarily or secondarily involved. In Quincke's case, the inflammatory process which led to thickening of the folds of the mesentery, and consequent obstruction to the flow of chyle, must have had its beginning in the peritoneum.

Symptomatology and Diagnosis of Affections of the Chyle-Conveying Channels.

The anomalies of position, formation, course, outlet, size, and structure of these channels have not been diagnosed during life. Prof. Winiwarter has recently made a hypothetical diagnosis of congenital occlusion of the thoracic duct in a case of intra-abdominal chylous effusion, observed in a child four months old, which after several tappings was, at last report, four months after having been first seen, alive and increasing in size. The presence of chyle in the abdominal cavity was not, however, even suspected, until demonstrated by the evacuation of the fluid.

Wounds of these channels may be diagnosed by the location and direction of the stab or puncture, in connection with the escape of the chyle either externally or into the pleural or peritoneal cavity and subsequent evacuation. As the effusion of chyle into either of these cavities can occur only through transudation or through solution of continuity of a large vessel, its escape externally, or presence in either cavity, must be held as the essential element of differential diagnosis. When the emitted fluid is the result of transudation, the quantity is never large, nor is the accumulation continuous and rapid. When poured out through an aperture in the walls of the vessels the opposite conditions are present. If no fluid escapes externally, then only the symptoms indicating a collection of a fluid in the cavity will be exhibited, the character of which can be ascertained only by evacuation.

No case of chylous ascites has been diagnosed previous to the observation of the evacuated fluid. The difference between chyle and the oily or fatty fluids, sometimes found in the serous cavities in connection with tuberculous and cancerous affections, is sufficiently distinct to distinguish one from the other. Chyle is a coagulable fluid, closely resembling fresh milk in color, consistence, and even in odor. In occasional cases chyle and the fatty fluid product of degenerative processes have been commingled, in consequence of erosion of the walls of some of the chyle-conveying vessels. In such cases the presence of chyle could be ascertained only by microscopic examination, which might exhibit the presence of the corpuscular characteristics of that fluid. Sometimes the odor of articles of diet has been detected in the milky fluid, and foods possessing a peculiar and distinctive odor have been supplied to facilitate a diagnosis. During digestion the contents of the chyle-conveying vessels are milky; but during the interval, the fluid is lymph, and may be a colorless, nearly transparent, slightly yellowish or greenish fluid, without any characteristic odor. The changing nature of the fluid under these varying conditions becomes an important element of diagnosis.

The experimental and post-mortem observations having established the possibility of a rupture along the course of these channels, most frequently occurring in the lacteals, when from any cause the flow of the chyle into the left subclavian vein is suddenly interrupted, a diagnosis of such rupture might be predicated upon the rapid accumulation of fluid in the peritoneal cavity, when associated with a sudden loss of appetite, acute emaciation and anæmia, rapid prostration, diminished secretion of urine, and the presence of such conditions as would suggest sudden occlusion of the thoracic duct at or near its junction with the vein, or sudden stoppage of the current of the chyle, as has been known to take place occasionally in heart affections.

The gradual, partial, and progressive narrowing of the thoracic duct has been frequently determined by the presence of a tumor, as for instance, an aortic aneurism, so located as to compress it, and co-

existing with the symptoms of mechanical impoverishment of the blood by its deprivation of the nutrient material. The writer retains a vivid recollection of a case seen in the Pennsylvania Hospital, under the care of the late Prof. William Pepper. The patient had a pulsating tumor located in the epigastrium, was completely paralyzed in both lower extremities, greatly emaciated and exhausted, and had a constant gnawing pain in the back opposite the tumor. The diagnosis of aortic aneurism, compression of the thoracic duct, and caries of the bodies of several vertebræ made by Dr. Pepper, was subsequently verified at the autopsy performed by the late Prof. John Neill.

The diagnosis of disease of the walls of these channels during life, is hardly possible. They belong to the curiosities of the post-mortem room. These diseases are most frequently, probably always, secondary, and the symptoms are so obscured by those belonging to the primary affection, that it is impossible to recognize them. The case of John Hammett, reported by Cooper, in which the walls of the thoracic duct and receptaculum were altered and thickened; the case of Anne Norris, reported by Graves and Stokes, in which the duct was distended to the size of the middle finger, hard, nodulated, and filled with pus: and the case of inflammation of the duct and receptaculum, reported by Worms, were observed by competent clinicians, yet in neither case was the diagnosis made during life. Worms insists that the duct was the seat of the primary disease, and attaches special importance to the deep-seated pains in the abdomen and radiating towards the sides, as denoting the locality of the disease which was discovered in the tissues of the duct. Though not the first to observe the presence of icterus in connection with diseases in which pus was found in the lymphatics, Worms insists that the yellow discoloration of the integumental tissues was due entirely to blood changes caused by pus in the duct.

Treatment.—The treatment of these affections is mainly palliative. In the experimental wound, by Monro, upon the receptaculum of a pig, a coagulum was formed, preventing the effusion of chyle, and recovery followed. Percival reports his case of supposed rupture cured, and Goodlad intimates that another case of wound of the duct would have recovered, except for the excesses of the patient. Rudolphi asserts that wounds of the thoracic duct are "fatal, not because no fresh chyle is sent to the blood, but they are absolutely fatal because the thoracic duct forbids any interference by art, and because in an existing external opening of the thoracic cavity and a sufficiently free efflux of the chyle discharged from the wound, death from starvation must occur sooner or later."

In cases of narrowing or occlusion of the duct by compression from tumors, cicatrices, or other causes, the chances of life are not so hopeless, because of the free anastomosis, and probable restoration of the channel of communication. Any considerable amount of fluid in either cavity necessitates tapping, which has to be repeated very soon. In those cases of effusion caused by cardiac affections, treatment must be addressed to the restoration and maintenance of heart power. The rapid exhaustion and acute anæmia so constantly following large losses of chyle or lymph, must be combated by rest, and a tonic and supporting treatment.

Intra-Abdominal Lymphatic Varices.

But few such cases have been reported, and in a majority of the instances, the varices have been mistaken for herniæ. The most remarkable of these cases was a specimen obtained by M. Amussat from the body of a youth, aged 19 years.

"During life the boy carried in each groin a large tumor, which was supposed to be a double inguinal hernia, and for which he had worn a truss. Suddenly, in the morning, having the previous day made a long journey on foot, he was seized with acute pains under the right breast and in the folds of the groins, difficult respiration, dry cough, cephalalgia, fever, and lancinating pains in the tumors; after some hours of intense suffering, he died.

"*Autopsy*, twenty hours after death. The abdominal cavity contained a large quantity of sanguinolent serum; no trace of peritonitis; on the left side a cyst containing the pus extended in the crural sheath to the inferior third of the thigh; on the right side the purulent collection did not pass so low, but pressed under the crural ring.

"After having turned out the thoracic viscera, diseased lymphatic vessels were discovered. Some were as large as quills. The mass of dilated and twisted vessels extending to the iliac fossæ was dissected out, and is represented in fig. 341.

"The iliac and crural masses of lymphatics were insufflated and unravelled, and it was discovered that the hernial tumors were enormously dilated lymphatic vessels. The iliac ganglia or glands had disappeared, and seemed to have been replaced by lymphatic vessels."

The following case, somewhat analogous to the above, was reported by the late Prof. Drinkard:—

The hernial tumor was discovered in the cadaver of a very black negro on the dissecting table; consequently it cannot be determined whether the condition was congenital or acquired.

"The tumor occupied nearly all the superior part of the groin, its upper boundary

slightly overlapping Poupart's ligament; ovoid in shape; about four inches in its long diameter by three and a half in its vertical diameter; baggy in appearance; the skin loose and sacculated towards the inner and inferior portions. To the touch, the tumor, at first mistaken for a femoral hernia, was soft, doughy, inelastic, its contents yielding to pressure, but slowly returning when it was removed. It appeared in some parts more compact and consistent than in the rest.

Fig. 341.

Mass of dilated lymph-vessels.

"On dissection a thickened superficial fascia was exposed. From the meshes of both of its layers protruded the cellulo-adipose tissue of the region. The tumor presented no connection with either the crural or inguinal ring, and appeared like a mass of cellulo-adipose tissue, interspersed with lymphatic glands evidently undergoing fatty degeneration, and presenting here and there, over its dissected surface and through its substance, patches of a pale rose color, resembling cellular tissue infiltrated with blood serum, and bearing in some points a closer resemblance to fresh muscular tissue."

Drinkard refers to another case, which he saw in the service of M. Nélaton (Hôpital des Cliniques), in 1863, and which the latter denominated glandular hypertrophic tumors, which are to be distinguished from those formed of "varicose lymphatics, and exude on incision a limpid lymph." In regard to this case, Nélaton remarked as follows:—

"The first idea given by the tumor is that it is formed by the testicle, which has become deviated in front of the abdominal aponeurosis, and an omental hernia has followed the testicle, which would give to the tumor the peculiar sensation experienced on palpation."

This, however, he excluded, for the reason that no pedicle traversed the inguinal canal.

In Drinkard's case the course of the lymphatics of the limb, leading to the tumor, was marked by bluish-black lines, which gave the limb a marbled aspect.

"M. Trélat refers to the case of a young man upon whom M. Nélaton operated by excising a lymphatic tumor. He says: "The diagnosis being uncertain, an incision was made over the mass, when a considerable quantity of thickish milk-like fluid escaped, leaving only irregular flaps, and some beaded filaments, which were removed. The patient, a robust man, was seized with rigors and symptoms of purulent absorption, and died. The tumor on the opposite side, which had not been operated on, was injected by M. Sappey, and was shown to consist of a network of varicose lymphatic vessels."

The succeeding case, reported by M. Trélat, exhibits conditions more strikingly resembling those found in Amussat's than in either Drinkard's or Nélaton's. The tumors in this case were mistaken by Trélat, Nélaton, and by the physicians of L'île Maurice for hernial sacs, and their true nature was not suspected during the lifetime of the patient.

"A youth, when 15 years of age, discovered a small enlargement below the left groin, and soon afterwards, while performing gymnastic exercises, he was seized with severe pain in the right side, which was supposed to proceed from an inguinal hernia. This was reduced and a truss applied, but the region above the pad remained enlarged, especially after walking or exertion. The tumor on the right side descended lower than on the left, but the latter reached as far upwards as the orifice of the inguinal canal, and was lobulated. The right tumor was more projecting, more regular, and softer. The skin was unchanged in color; its surface was regular, normal, and it was movable over the tumors. The swellings were movable over the deeper parts, were soft, could be compressed, felt like lipomata, and were reducible.

"Subsequently, in consequence of a subcutaneous abscess, a fistula was established at the level of the fold of the nates of the left side, about five centimetres from the anus, but did not communicate with the intestine. A few days after an operation for the radical cure of this fistula, the two inguinal tumors became painful, exquisitely sensitive, accompanied with a group of grave symptoms, under which the patient rapidly sank and died.

"*Autopsy.*—The right tumor was situated in greater part under the cribriform fascia, in front of the aponeurosis of the psoas and abductors, consisted of lobes approximating each other, was definitely bounded above, below, and at the sides, but behind communicated with the deep lymphatic vessels. From it was discharged, in great abundance, a rose-colored fluid. No hernia could be discovered, but varicose lymphatic vessels occupied the inguinal canal and the superior portion of the cords.

"Upon removal of the peritoneum from the posterior abdominal wall, there was observed along the iliac vessels a mass of wrapped conduits rolled together, directed generally from below upwards. This condition existed on both sides. Towards the columns of the diaphragm these two masses approached, and were probably blended together under the diaphragm. These masses were formed by the dilatation of lymphatic vessels, and resembled exactly the design given by Breschet of the condition found in the case of Amussat. (See fig. 341.)

In this connection, I reproduce the cases of Petit and Aimé-David, in neither of which was the diagnosis of lymph varices verified.

"A student had for a year noticed, more particularly after fatigue, a swelling in each groin, which was accompanied with some pain, extending down the thighs. Examination showed tumors in both groins without any change in the color of the skin. The tumors extended into the inguinal canals, and were painful to the touch; the pain extended along the saphena, which region presented the characters of angioleucitis. The child left the lyceum and returned in eight days, carrying a double hernia bandage. The former condition returned; the tumors doubled in size; the limbs became œdematous and benumbed.

"In a mulatto, about thirty years of age, as a result of repeated angioleucitis, a very extensive enlargement of the legs developed. At the internal region of the thighs there were present prominent tumors consisting of dilated lymph-vessels. The tumors were uneven, elastic, transparent, and under pressure receded into the abdomen."

Aimé-David refers to another case observed by M. Denis, in which the tumors presented were analogous to those found in the patient of Petit. The patient also carried a double hydrocele.

The tumor observed by Petters in the right inguinal region of a patient, equalled in size a small apple, and resembled a hernia. It "felt like a conglomeration of ascarides—like rebounding cords—which upon pressure with the finger became softer and more flaccid." Petters regarded this anomaly as a "venous plexus," but it consisted of the "glands of the right inguinal region transformed into cysts of small walnut-size, filled with wine-yellow fluid. From the inner wall of these cysts, trabecular projections extended into the cavity, and it was possible to enter two dilated lymph-vessels of crow-quill size, which connected the cysts with one another, so that a dilated vas efferens and afferens could be seen in each cyst. Upon puncture a yellowish fluid spouted from these cysts in a jet of several inches. Lymph-vessels and cysts together formed a conglomeration which it was difficult to unravel. The lymph-vessels in the vicinity, and the thoracic duct, showed considerable dilatation." This case was complicated with stenosis of both auriculo-ventricular orifices, enlargement of the heart, œdema, ascites, and cirrhosis, and it does not seem possible to have correctly diagnosed the true nature of the inguinal tumor, which was only recognized after paracentesis.

Diagnosis.—In Amussat's case death speedily ensued, preceded by violent symptoms, which developed suddenly after a fatiguing walk; in Nélaton's, death followed, in a few days, an operation; and in Trélat's, it followed an operation for fistula in ano, unaccompanied with any trace of redness or inflammation about the wound, without erysipelas or any appearance of angioleucitis. In these cases, as also in those of Petters and Petit, the tumors had been mistaken for hernial sacs. It thus becomes important to differentiate them from herniæ. Gjorgiewic asserts that lymphangiectatic tumors may be confounded with reducible and irreducible tumors. Among the latter may be classed cold abscesses, cysts, and lipomata, which develop very slowly, like lymphangiectatic tumors, but from which they differ by their reducibleness, transparency, and indistinct feeling of fluctuation, resembling that of lipomata, but quite distinct from that of tumors containing fluid. Softness is a characteristic of lipomata, but the latter are fixed. They may be compressed but not reduced. Lipomata are rarely developed symmetrically (Trélat), whilst the inguinal glands may be affected on both sides. Of the reducible tumors they are most frequently mistaken for herniæ. Both, says Gjorgiewic, develop slowly; neither change the appearance and character of the covering integument; both increase in size during exercise and continued maintenance of erect posture, and both usually recede in the horizontal posture. In the

latter position, however, the hernial tumors do not recede unaided, but the glandular tumors do. Aime-David insists that the existence of a dilatation of the lymphatic vessels of a neighboring part would be presumptive of the character of the tumor. Drinkard invites attention to the differing compactness and consistency of the parts of the tumor in his case, and to the absence of any impulse on straining or coughing, the invariable size of the tumor, and the history of the case, as sufficient to prevent a mistake in diagnosis. But in the case of Trélat the history was suggestive of the presence of hernia, for the tumor in the right groin developed during violent exertion; and in the case of Amussat the tumors developed gradually, were reducible at pleasure, and protruded immediately upon removal of the compressing appliances. In the debate which took place before the Surgical Society of Paris, where M. Trélat first presented his patient for examination, M. Verneuil "gave the opinion that the deep and intra-abdominal lymphatic vessels were dilated, and had perhaps been the point of the departure of the disease," which opinion was verified by the autopsy, but M. Trélat, in his report of the case, does not give the reasons which enabled Verneuil to arrive at so accurate a diagnosis. No reference is made, in any of the reports of the cases, to percussion as a means of diagnosis. But, perhaps, the only conclusive test must be derived from aspiration. The presence of a fluid, presenting the chemical and microscopical characters of lymph, would settle the diagnosis. A lobulated feel, or the sensation of a congeries of twisted cords, unattached and movable under the skin, or the continual presence of a swelling around the truss, as in Trélat's case, which enlarged when in the erect position, should excite a doubt as to the hernial character of the tumor. The following case of Fetzer presented concomitant phenomena which should remove all doubt as to the character of the tumors.

"A girl, 16 years old, had, besides a double femoral hernia which had existed since her eighth year, upon her abdomen, a ribbon-like stripe, commencing one inch below the navel to the left of the linea alba, continuing to the left and upwards, and passing between the false ribs and the ilium, proceeding thence, becoming lighter in color and narrower, as far as the vertebral column. Upon this band, anteriorly upon the abdominal walls, one inch below the navel and two lines from the linea alba, was a conglomeration of several wart-like tumors, from the size of a male to that of a female nipple, and of the same color as the surrounding skin. They were painless, flaccid, could be pressed into the abdominal walls, but rose upon the removal of the pressure. From two of the protuberances a milk-like fluid exuded, drop by drop. The flow issued from a small red spot in the centre of the tumors, was increased by pressure upon any of the unruptured bodies. After standing a short time the fluid separated into a milky, turbid serum, rendered clear by ether, and a brighter, milky, large coagulum, which reddened upon exposure to the air. Fetzer removed one of the protuberances, and from the opening issued a quantity of the milky fluid, which was followed by great debility, languor, and a feeble pulse. The entire band was thickly studded with minute raised points. Into the opening a probe could be passed to the depth of one inch. Chemical analysis of the fluid by Prof. Köstlia, and microscopical examination by Prof. Schlossberger, proved it to be lymph.

The history of the above case is incomplete, and, consequently, the true nature of the hernial tumors must remain in doubt, but the probability is they were similar to the masses of dilated lymphatic vessels found in the cases of Drinkard and Trélat. If such was their character, the coincident diseased condition of the lymphatics of the abdominal wall becomes an important aid in determining a correct diagnosis. Not that such a condition is necessary to exclude the existence of true herniæ, but that the concurrence of tumors resembling herniæ and dilatation of the lymphatic vessels of the abdominal parietes would determine the lymphatic nature of the tumors.

Chylous Hydrocele; Galactocele; Chylocele.

Cases of effusion of a milky fluid into the tunica vaginalis testis have been reported by Aug. Vidal (de Cassis), Ruthnum, Ferguson, and Mastin.

The fluid in the case of Vidal was composed of water, a substance differing from albumen, but very analogous to, if not identical with casein, a fatty substance presenting the physical characteristics of butter, sugar, chloride of sodium, and some traces of lime, probably the chloride. It was alkaline and coagulated spontaneously. There were seen under the microscope a multitude of small globules, some spherical, others irregular, but all having the appearance of the globules of butter. In the case of Ruthnum the contents were the "color of milk, with a greenish-yellow tinge, thick, and coagulated spontaneously. Neither mucus nor pus was found." In Ferguson's case the fluid was alkaline, had a specific gravity of 1019, was in appearance undistinguishable from milk, and emitted a peculiar odor. "The milky appearance was due to the presence of fat, which,

having been dissolved by ether, left the liquid transparent, like ordinary hydrocele fluid. Heat and nitric acid caused a copious deposit of albumen, and the aqueous part contained sugar and a protein substance resembling casein in its reaction. The inorganic ingredients consisted of lime, soda, and potash, in combination with phosphoric, sulphuric, and hydrochloric acids." In Mastin's case the fluid was "in its physical and chemical characters comparable to chyle."

Causes.—The patients of Vidal and Mastin had had gonorrhœa, accompanied, probably, with inflammation of a single, or a group of lymphatic glands, sufficient to obliterate one or more afferent vessels, thus interrupting the onward movement of the lymph, and producing dilatation and rupture of the distal extremity of the vessels, or of the lymph spaces of a very limited area. The two cases do not establish the causal relation of the gonorrhœa, but a number of cases have been reported in which dilatation, sometimes followed by rupture, of the lymph-vessels of the integument of the penis, especially about the prepuce, has followed gonorrhœa, balanitis, and even more trivial inflammations, and slight abrasions.

Dr. Mastin was the first to observe a lymphatic varix on the surface of the tunica vaginalis testis, though Lebert, as early as 1855, had suggested the probability of such an occurrence in cases of chylous hydrocele. Mastin found upon the smooth, polished, and pearly white surface of the tunic, at the point of beginning of its reflexion over the testis, "a small granular-looking mass about the size of an ordinary English pea," which when snipped off exhibited the "patulous mouths of three or four small vessels," which he believed were lymphatics. Varices have been frequently observed in the superficial and deep-seated integumentary lymphatic plexuses, but rarely in the serous membranes. Morton, in 1689, and Mascagni, in 1787, observed varices of the pulmonary lymphatics; Caldani, in 1791, described a varix of the lymph vessels of the heart; Walther, in 1787, and Sandifort, in 1780, recorded cases of dilatation of the lymph vessels of the small intestines; in the latter case the varix resulted from obstruction of the lacteals caused by intussusception. Sœmmerring described dilatation of the lymphatics of the duodenum and of the intestines in herniæ. He also refers to instances in which he had observed the lymphatics of the liver and spleen "filled with a whitish material," and Lebert asserts that he had frequently seen the lymphatics on the surface of the liver and lungs dilated. Schreger and Tilesius saw a case of dilatation of the lymphatics of the conjunctiva.

Diagnosis.—The diagnosis must be determined by the ordinary symptoms of a collection of fluid in the cavity of the tunica vaginalis testis, and the opacity of the tumor. Vidal observed the absence of transparency, a test which does not seem to have been employed by either Ruthnum, Ferguson or Mastin, but neither of them suspected the character of the fluid previous to its evacuation.

Ferguson also invites attention to the fact, that in his case the evacuated fluid differed only from ordinary hydrocele fluid in the presence of oleaginous matter; but the analyses of Grassi and Tyson characterize the fluid in the cases of Vidal and Mastin as lymph, its opacity and milky appearance being due to the presence of an unusual proportion of fat.

Treatment.—Ruthnum evacuated the fluid and injected the cavity with equal parts of the tincture of iodine and water, which effected a complete cure. Mastin dissected back the open vessels for a short distance and then "tied the bundle *en masse*, with a small and very strong silk ligature; then carefully excised all the front wall of the tunica and with four or five delicate silk sutures coaptated the edges of the sac, so as to close up the cavity, leaving one end of each suture free. The free ends of the sutures and of the ligature were then brought outside, and having passed through the sac a small drainage tube, closed the incision in the integument with pin sutures." The parts were dressed with a lotion of lead water and arnica. A full dose of quinine with forty drops of McMunn's elixir of opium were given. The case progressed rapidly, and on the fourth day the integument had united by first intention. Three weeks after the operation the patient was discharged entirely well.

Fistulæ and Varices of the Lymph Vessels of the Penis and Perineum.

The numerous valves with which the lymphatic vessels are supplied prevent regurgitation only so far as the superimposed volume of fluid is insufficient to impair their integrity, or where there is no solution of the continuity of the vascular walls, and distension is within the limits of ordinary and normal extensibility. In cases of lymphangiectasis it is not necessary, usually, to look beyond the nearest neighboring and connected glands, for the cause of such distension. Nature has wisely multiplied the number of valves in the afferent vessels the nearer they approach the glands, as well to modify and direct the flow as to prevent regurgita-

tion; but if from any cause the passage of the lymph through the glands is obstructed or prevented, dilatation of the afferent vessels will ensue, and it is not improbable that a reflex movement may take place. Valvular insufficiency and dilatation may exist in opposite relations to each other, either as cause or effect. Insufficiency, which may result from congenital defect or from disease primarily attacking the valves, would produce stasis of the fluid flowing in the vessels, the accumulated fluid would produce distension of the walls of the vessels, and the coats losing their normal contractility, permanent dilatation would ensue. Insufficiency resulting from vascular distension would be a mechanical process. The dilatation of a vessel may result from a thinning or loss of contractility of its walls, from increased resistance to the onward movement of the fluid, and perhaps, also, from the lesser expansibility of the intima than of the adventitia. In any intervalvular section of a vessel thus dilated, the lateral pressure of the accumulated fluid would constantly increase until the unaltered valve immediately behind would prove insufficient to maintain the weight, or its semilunar segments might be forcibly separated by the increased calibre of the varicose vessel. Lymphatic varices usually have their beginning in the vessels and extend to the plexuses, but the plexuses may be alone affected. Varicosities always progress backwards from the point of arrest of the flow of the contained fluid, and may result from simple repletion of each proximal intervalvular section, without any valvular insufficiency. This mode of producing lymphatic ecstasis is well illustrated in Beau's cases of varicose dilatation of the lymphatic vessels of the prepuce, in which the integrity of the valves was preserved.

"In order," says Beau, "to obtain a good view of the lymphatic varicosity, the folds of the prepuce must be obliterated by the drawing down and tension of the skin of the penis. Then it appears in the form of a little rounded cord, resistant and hard to the finger, in which has accumulated a limpid, aqueous liquid, which cannot be expelled through either of its extremities. The varicose vessel being confounded with the folds of the prepuce, and directed, like them, from behind forwards and from above downwards, there is a dorsal extremity situated near the median line, and a frænal extremity, bordering upon the frænum of the prepuce. This cord presents, in its continuity, intersections which mark the presence of lymphatic valves. As a proof, if with a fine needle a slight puncture is made in the dilated cord towards its frænal extremity, only that portion is emptied which is situated between the puncture and intersection, but if the puncture is made in the dorsal extremity, the cord is emptied in its whole extent."

The course of the lymph is towards the dorsal extremity, in which direction the valves open, and the failure to discharge the fluid except by puncture at the dorsal extremity establishes the competency of the valves. Meckel says, "the hydatids of the lymphatic vessels seem many times to proceed from a dilatation of these vessels, closed at both ends by valvules; rendered more probable again by those cases in which have been found hydatids filled with water, in direct communication with lymphatic vessels."

The widening of the vessels immediately above the valves, sometimes even into sacular dilatations, which gives to the vessel when distended a moniliform appearance, may be a provision of nature to accommodate moderate accumulations of fluid in the intervalvular segments, thus preventing injury to the vascular walls, and providing for the ordinary irregularities in the volume of fluid, and for the intermittent operation of the forces concerned in the locomotion of the lymph.

A similar condition, representing dilatation, occlusion and valvular insufficiency, with fistulous orifices at each terminus of the telangiectasis, through which the fluid could be discharged simultaneously, is exhibited in the following case of lymphatic varices of the penis, occurring in a man 30 years old, reported by Dufour.

"A year previously he contracted a urethritis, the acute period of which was complicated with lymphangitis of the prepuce and œdema; resolution took place, but there remained on the inferior surface of the penis little nodosities near the raphé. On the left side a reddish, nipple-like pimple was to be seen, terminating at its summit by a grayish point alternately opened and closed. From this there passed a subcutaneous knotted cord, parallel to the median raphé of the penis; the skin was not adherent, and had not changed its color. At its posterior extremity the cord terminated in a nodosity, adherent to the skin, and on which existed two grayish openings resembling the one before described; pressure being made upon the knotted cord, a sero-purulent fluid escaped from all the openings; a stylet introduced into one opening penetrated the cord and passed out through an opening at the other extremity. Between the openings described there existed another in the middle of the cord, at which point the cord adhered to the subcutaneous cellular tissue, which M. Ricord thought was the point of anastomosis of the affected with the healthy lymphatics."

The valves, though incompetent, were present, and by their incomplete operation preserved to the dilated vessel the charac-

teristic knotted condition. When entirely absent, either through congenital defect or destruction by disease, such portion of a vessel will expand uniformly, presenting no intersections marked by constrictions, or, it may be this latter condition, arising in like manner as the hydatid or bladder-like, or the rosary-like form of dilatation, is simply an advanced stage of the same process, marked by very great thinning and transparency of the vascular walls. This form of ectasis is exhibited in the following case, reported by Huguier, of dilatation of the lymphatic vessels of the penis.

"A man, aged 39 years, had been affected with a right inguinal hernia, and for two years had used a bandage. On the penis, at the base of the glans, was a crown of transparent vessels, hard, tortuous, and three or four millimetres in diameter. These vessels seemed to arise about the frænum of the prepuce, from whence could be seen each dividing into three or four branches, a little smaller, but quite as hard and tortuous, crossing towards the root of the penis and dipping into the fibrous tissue of the envelope of that organ." Through a puncture, "a dull, almost colorless fluid" escaped, followed by collapse of the vessels.

And yet more interesting is the case of dilatation of the lymph vessels of the penis, caused by stasis of lymph, reported by Friedreich, which exhibits both the rosary-like form and the equable expansion of the vessels.

"K. K., aged 18, had a simple, non-indurated chancre upon the external skin of the penis. It cicatrized after a short time, and left no appreciable puckering of the skin. When nearly healed, the lymphatic glands of both inguinal regions began to swell and to pain, followed by turgescence and a painless swelling of the whole penis. Simultaneously was observed a vessel surrounding the corona glandis like a ring, having its beginning on both sides of the frænum, running thence upwards in the furrow behind the corona, and continued above in a thicker second vessel; which extended along the median line to the root of the penis, but receded gradually inwards, escaping more and more from view, and finally could only be discovered by the touch. These vessels were very prominent above the surface; felt full, elastic, painless, and were recognized as largely dilated lymph-vessels by their whey-like, dull-white contents, as well as by their rosary-like arrangement. From the circular vessels radiated numerous thinner vessels, of the calibre of knitting-needles, which carried the same contents, but being dilated equally, did not present the same rosary-like arrangement, and which, receding after a short course upon the glans into the deeper tissues, soon escaped from view. The inguinal glands were incised as soon as fluctuation was felt, and a quantity of pus was discharged from the cellular tissue surrounding the glands, the infiltrated lymphatic glands protruding at the bottom of the opened abscess in the form of nodular tumors, and of flesh-red color. The wounds closed in a short time, the glandular tumors were reabsorbed, and *pari passu* the dilated lymph-vessels were reduced to their normal lumen."

The lymph stasis resulted from the impermeability of the inguinal glands, occasioned by the compression of the inflamed and surrounding cellular tissue. The concurrent glandular tumefaction and vascular dilatation, and their gradual subsidence, with the restoration of the channels through the glands, directly connect the two conditions as cause and effect. The varying form of the ectasia, which was equable in the smaller, and irregular and bead-like in those of the next order, leaves but little doubt of the absence of valves from the former and of their presence in the latter; and the gradual contraction of the vascular walls with the removal of the accumulated fluid, and the maintenance of their normal conditions, suggests, also, the restoration of the valves to their proper action, if, indeed, they were rendered incompetent during the continuance of the lymph stasis.

The patient of Zambaco had always "carried on the posterior portion of the raphé of the scrotum two little prominences, of soft consistency, variable size, globular, and transparent," which ruptured spontaneously and discharged an "opaline, whitish, milky fluid." Subsequently two vesicles formed at the root of the penis and ruptured, discharging a similar fluid. The prominences and vesicles were arranged along an antero-posterior line —a projecting, irregular, knotted cord, at points more distant than at others, and from all the fistulæ there was a continuous discharge. Pressure from behind forwards increased the discharge. In this case there does not seem to have been any incompetency, but immobility of the valves, which impeded the current of the lymph, and produced the dilatation of the vessels and rupture at the points where the fluid accumulated in excess.

M. Verneuil has seen at the base of the glans penis an enormous dilatation of the lymph-vessels, which presented the appearance of successive tumors in the form of a rosary.

Hamilton reports the case of a child, aged three years, "with phimosis and adhesion of the prepuce to the glans penis. Along the raphé of the scrotum, extending from an inch in front of the anus to the glans penis, was an elevated sinus with transparent walls about the size of a crow's-quill, closed at both ends, and nearly filled with a whitish, cream-like fluid, which could be seen to pass from one end to the other when pressure was made."

Hensen reports the case of a boy, aged 10, who had upon the prepuce an opening, from which was discharged a fluid slightly colored red from the presence of red blood-corpuscles, and which after standing became milk-white. The scrotum, without being very much enlarged, had upon its surface numerous white vesicles, from which, when punctured, poured a milk-white fluid, sometimes in very great quantities. The fluid discharged through the preputial fistula came from a varicose lymph-vessel.

Causes.—These varices may be caused by urethritis, balanitis, chancre, impermeable glands, periadenitis, and congenital defects, which produce narrowing or occlusion of the vessels. The most frequent cause is coitus.

Diagnosis.—The varices being confined to the superficial lymph vessels, the diagnosis is usually easily made by the appearance of hard, knotted, flexible cords along the course of the vessel. When ampullar, they are like rounded tumors, unattached to the skin, are depressible, and resume their form when the pressure is removed. When located in the prepuce, the dilated cord offers resistance and hardness to touch. The fluid cannot be expelled through either extremity when the valves are competent, and the cord is divided in its continuity into sections marked by the valves. The dilated vessel is confounded with the prepuce, and is divided into two extremities—a dorsal extremity, situated near the median line of the back of the penis, and a frænal extremity, bordering upon the frænum of the penis. Sometimes the fluid discharged through a fistula or puncture is dull and almost colorless, in other cases it is milky. In certain forms collapse of the vessels follows puncture. The affection when caused by coitus is at first usually intermittent, but after frequent recurrence, become permanent.

Treatment.—Several methods have been devised. Ricord seized the knotted cord of the size of a crow's quill, which ran parallel to the median line of the raphé of the penis, with a pair of forceps, and excised the fold so formed, cutting with the bistoury all that was above the forceps, and then excised a portion of the deep wall of the vessel which was at the bottom of the wound. The edges of the wound were brought together by serres-fines. Union took place by the first intention. The treatment by Beau varies according as the affection may be intermittent or continuous. In the first case he employs with much success astringents and tonics, such as cold water, solutions of acetate of lead, alum, hydrochlorate of ammonia, using them as lotions, especially as local baths. But when the varicosity has become continuous and existed for some time, he performs the following operation. After having caused the varicose cord to bulge out as much as possible by proper pressure, he passes an ordinary fine needle, armed with a thread, into the frænal extremity and along the vessel for a distance of a centimetre, then out through the wall of the vessel, and disengaging it from the thread, ties the two ends of the thread traversing the varix, and folding it up conceals it in the *cul de sac* of the prepuce which covers the glans penis. As soon as sufficient inflammatory action is set up, which usually occurs in three or four hours, and is determined by moderate pain and slight œdema of the prepuce at the frænal end, the thread is cut and carefully removed. For several hours a serous effusion escapes through both apertures. The œdematous swelling disappears in a few days, leaving a decided prominence of that portion of the varicose cord traversed by the thread. It remains hard, slightly painful on pressure, becomes opaque, and gradually diminishes in size. In two or three months the vessel is so reduced that it is lost in the mucous membrane of the prepuce. It is not necessary that the thread should traverse the whole length of the varicose vessel, but it is essential that it should be introduced through the frænal end, for as the movement of the lymph is towards the dorsal extremity, it must follow that when the frænal end is obliterated, the efflux of lymph ceases, and the entire vessel will disappear. When the varix is produced by the presence of enlarged glands, or periadenitis, the removal of such cause will restore the permeability of the vessel or vessels, and the varix will disappear.

Lymph Scrotum; Chyloderma; Pachydermia Lymphangiectatica.

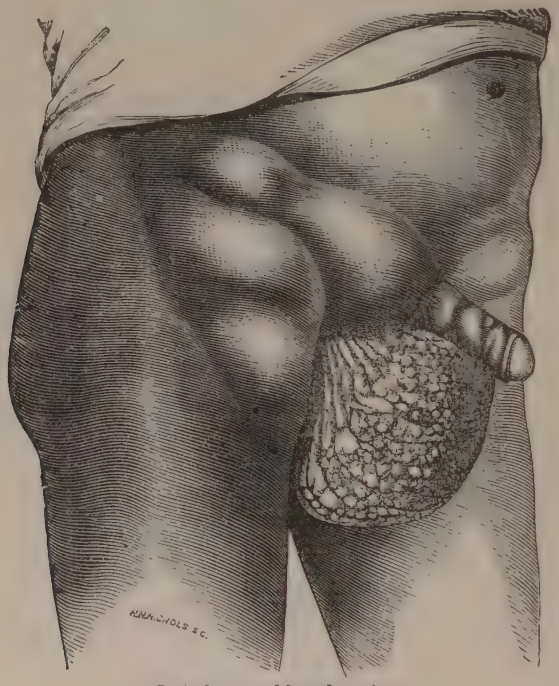
This disease is characterized by vesicle formations thickly studding the surface of the scrotum, formed by partial ampullar dilatations of the superficial subpapillary lymphatic net. The inner surface (Rindfleisch) of the vesicles is always lined with lymphatic endothelium, and the covering is formed by the epidermis and papillary layer. They are found in regions rich in organic muscles, which in the tunica dartos forms "a proper membranous organ." Rindfleisch says this muscular element undergoes a special hyperplasia, and by contraction compresses the lymphatic trunks which penetrate the cutis in a straight direction, and connect the superficial with the deep vessels, thus preventing afflux of lymph, and producing ampullar dilatation of the terminal radicles. It is generally, if not always, associated with enlarged and indurated

groin glands, which are rendered impermeable, and it is not improbable that the vesicle formations and the hypertrophy of the dartos may be effects of the obstruction to the lymph-stream.

Numerous cases have been reported, especially by Carter and Manson, and all belong to the acquired forms of lymph varices. The following case, reported by Carter, presents a number of interesting phenomena.

"The skin of the scrotum was corrugated, thickened, and studded with numerous tubercles, varying in size from a pin's head to a pea, soft to the touch, and when punctured discharged a chylous fluid, sometimes equalling a pound daily. Sometimes it issued spontaneously from one or more of the tubercles. When it ceased, and occasionally during its continuance, the urine became chylous and frequently coagulated. The inguinal glands on both sides were much enlarged (see fig. 342), soft, doughy, and diminished under pressure. The tumefaction of these glands seemed to alternate with the appearance of chyle in the urine, and increased two or three hours after a full meal, and then subsided. The appearance of chyle in the

Fig. 342.



Carter's case of lymph-varices.

urine was irregular; when chylous, it was either white, reddish-white, or pinkish, with a subsequent deposit of blood corpuscles. It usually coagulated more or less completely, the clot assuming a rose color.

"The fluid discharged from the scrotum, while flowing, assumed a red color, coagulated very rapidly, the clot being red, and the serum milky. It consisted of a molecular base, granules, and red blood-corpuscles, some well formed, some granular and starred."

Wiedel reports the case of a "boy, aged 18, upon whose scrotum were a multitude of pale yellow vesicles. From one of the largest, which he punctured, a milk-like fluid was ejected in a jet, which, upon chemical examination, proved to be lymph. This condition continued until he reached the age of fifteen, when the scrotum became suddenly inflamed, red, very painful, and enlarged to three times its size. The inflammation extended to the perineum and adjacent skin; a large tumor formed between the scrotum and anus, which subsequently ruptured and continued to discharge a considerable quantity of watery fluid. In consequence of these continual losses, his strength gave way, and he died of phthisis pulmonalis."

Verneuil reports the following case, which exhibits this affection in a different aspect.

"The patient was affected by a chronic swelling, with induration and cutaneous hypertrophy of the scrotum, of the inguinal regions, and of the two thighs. The thickened skin was covered with rounded prominences, firm to the touch, sessile, but little vascular. One variety was due to the

hypertrophy of the papillæ, and the other enclosed ampullar dilatations of the lymphatic vessels. From the latter, when excoriated or pricked, oozed a lemon-colored liquid, slightly viscid, transparent, like a weak solution of gum-water. In the left inguinal fold there were two soft prominences, violet-colored, fluctuating, and covered with a crust, on the removal of which there escaped a quantity of fluid similar to that above described. The patient had frequently recurring inflammatory attacks, which always caused an augmentation of the affected parts, which progressive increase always proceeded from above downwards."

M. Verneuil rejected the hypothesis of elephantiasis Arabum, and insisted that it was a special variety of hypertrophy which was connected with a dilatation of the superficial lymphatic vessels.

In the discussion which took place before the Chirurgical Society of Paris, Demarquay admitted the dilatation of the lymph vessels, but insisted that the hypertrophy was elephantoid because of the extent of tissue involved, the small quantity of fluid discharged, and the absence of a jet, which, he erroneously maintained, is the invariable manner of escape of the fluid from a varix of the superficial lymphatic network. In this view M. Trélat coincided, and held, furthermore, that the dilatation of the deep network of lymph vessels was not established, for in all such cases there was found "a circumscribed tumor of greater or less extent, without alteration of the skin," which might be mistaken for a hernia or a lipoma. The extent of the hypertrophy, induration of the tissues and papillary growths, M. Trélat's assertion to the contrary notwithstanding, do not antagonize the hypothesis of M. Verneuil, for in a number of cases similar morbid conditions were manifestly associated with dilatation and occlusion of lymph channels. M. Panas had seen two cases of dilatation of the superficial lymphatic network of the scrotum, but neither had anything analogous to the case of M. Verneuil. In both of his cases the fluid was evacuated by puncture and escaped with a jet. In one case the lymphatic dilatation followed a balanitis. The essential question in dispute related to the priority of the conditions—whether the elephantiasis or the disease of the lymphatics was the primary condition. In cases like this, in which "the affection began without known cause by violent pains and inflammatory swelling," the usual course of the acquired forms, it is not easy to settle the priority of conditions, for usually, when unaccompanied with a discharge, the affection is not observed until pain and swelling are present. In those cases in which discharge occurs prior to the onset of the symptoms which are so markedly present in elephantoid developments, the question of priority is settled in favor of the primary affection of the lymph-vascular system, and in such cases, especially of the acquired forms, the subsequent progress does not differ materially from those cases where the first observable phenomena are characterized by pain and inflammatory swelling, such as occurs in elephantiasis Arabum, which it is claimed produces stenosis and obliteration of lymph vessels, and consequently dilatation of vessels, stasis of lymph, induration and hypertrophy of the tissues. It cannot, however, be denied that inflammatory processes, either erysipelatous or elephantoid, do constitute the beginning of many of the cases of hypertrophic development, which are characterized by all the phenomena which are ascribed to occlusion and dilatation of lymph channels, and consequent stasis of lymph.

As an instance in point, the case reported by Roberts possesses peculiar interest.

"The patient, aged 45, had, during several years, numerous abscesses. After the last had healed there were observed a number of transparent vesicles scattered over the abdomen, occupying the hypogastric region from the umbilicus to the pubis, thickest near the centre of the hypogastrium, and smaller and more sparse towards the confines of the affected region. A cluster of large vesicles is situated near the umbilicus, and another larger cluster is near the upper and right external limit, as shown in fig. 343.

"Some of the groups contain three or four, others eight or ten, vesicles, closely aggregated together. Some are so small that they are just visible. Most of them are hemispherical, but some are oblong or irregular, as if two or more had coalesced. In the smaller vesicles the membrane is transparent, without a trace of organization, their opaque white contents shining through them like drops of rich milk. They varied in color and fulness—the whiter the more distended, and when pale they were flaccid. The color was also affected by the state of the patient's health, and by the digestion and assimilation of food; when feverish they were pale; but when the appetite and sleep returned, they became milky and turgid. As his health finally declined the milky appearance became less marked, and in the last week of his life they became permanently pale and flaccid. They were paler in the morning before breakfast, after the prolonged fast of the night. Soon after breakfast they began to grow fuller and whiter, which increased through the day, and attained its maximum about eight hours after dinner. The discharge followed the same rule. When a vesicle was gently pressed, it immediately emptied, its contents escaping into deeper parts, but returning as soon as the pressure was removed.

They did not communicate with one another, but after a copious discharge all became empty.

"The condition of the urine was carefully noted during the progress of the case. It varied in quantity per day; was most abundant when there was no discharge from the vesicles. On several occasions the urine was chylous, and on microscopic and chemical examination, excepting the ordinary constituents of urine, presented all the characters of the milky discharge.

Fig. 343.

Roberts's case.

"*Autopsy*, twenty-one hours after death. Both lungs studded with gray granulations. Two small vomicæ were found in the left apex, and one in the right. Tuberculous ulcers were found in the small and large intestines. The bronchial and mesenteric glands were enlarged. The liver, spleen, kidneys, and bladder were healthy. The integument of the hypogastrium was much thickened and spongy. The lining membrane of the bladder appeared smooth, glistening, and healthy.

"Examination of a portion of the diseased skin.—A vertical section exhibited disease of the cutis vera and the subcutaneous tissue. The tendinous, muscular, and peritoneal strata of the abdominal wall were normal. The skin was immensely thickened, and formed with the subcutaneous tissue a pad, varying from a half to an inch in thickness. When fresh, the cut surface had a pale rose color and somewhat fleshy or granular appearance. It was traversed by short ducts or lacunæ, varying from the width of a crow's quill to that of a hair. On microscopic examination the lacunæ could be seen to communicate freely with one another by small orifices. The vesicles constituted the surface boundaries of the superficial lacunæ. The lining membrane of the vesicles and of the lacunæ was smooth, glistening, and lined with spherical nucleated cells."

Chyluria is quite frequently associated with lymph scrotum and chyloderma, and the former is constantly co-existent with enlarged and indurated groin glands.

Causes.—The frequency of the termination of lymph scrotum and chyloderma in phthisis indicates the presence of a dyscrasia either as cause or effect. The fact that nearly all the cases of lymph scrotum have occurred in China and India points to some endemic agency. Many of Manson's cases were associated with chronic malarial poison. A meagre and inadequate diet, mainly composed of vegetables, principally rice and sweet potatoes, must be recognized as a predisposing cause. Want, poverty, and suffering are equally potential. In the localities where this affection is most common, all these agencies are combined. Obstruction to the lymph stream is, however, the essential element of cause. Chyluria, lymph scrotum, chyloderma, and elephantiasis are frequently associated conditions, and it is maintained by some that all are forms of the same morbid condition, and due to the same cause—the presence of *filaria sanguinis hominis*. It is admitted that filariæ are the cause of chyluria and lymph scrotum. Manson claims that obstruction of the lymph circulation through the groin glands is produced directly by the ova or embryos of the filariæ, or indirectly by causing inflammation.

Symptoms.—Enlargement and thickening of the scrotum, the presence of vesicles filled either with a milk-like or transparent fluid. When rupture has occurred, lymphorrhagia, enlarged and obstructed groin glands; filaria, embryos in glands, and, perhaps, in discharged lymph; and when the lymph circulation is totally obstructed, excessive accumulation in the tissues on the distal side of the obstruction, solidification and condensation of the tissues.

Treatment.—The treatment is not very satisfactory. The restoration of the general health by an improved hygiene and more nutritious diet may arrest the further progress of the affection. When the obstruction is caused by inflammation of the groin glands, the arrest of the inflammatory process may restore the circulation. Amputation of the scrotum is

the only practical method of relieving the sufferer of the local inconveniences, but this does not always effect a radical cure. The operation is sometimes followed by elephantiasis of one or both lower extremities. In those cases where a spontaneous discharge takes place, the operation seems to be contra-indicated, because they are less frequently followed by elephantiasis than when the scrotum has been amputated.

Wounds of Lymph Vessels.

Traumatic injuries of the absorbent vessels seem to have been a subject peculiarly attractive to many of the older authors. Ruysch, as early as 1665, drew attention to wounds of the lymphatic vessels, and refers to a certain surgeon, "who had unfortunately cut a lymphatic vessel in incising a venereal bubo not completely developed, from which flowed daily a great quantity of lymph." Solingen, in 1693, reported two cases of "lymph fistulæ situated at the head of the soleus muscle, one consequent upon a wound, the other produced by contortion of the limb." Muys, in 1695, saw a young man who had been wounded in the left external malleolus, and from the wound "there flowed every day a vast quantity of water." Nuck, in 1733, wrote of wounds of the lymphatic vessels. "Very often," he says, "in venesection performed on the arm, and especially when performed on the foot, the absorbent vessels are injured; by carelessness in regard to these vessels the lancet has proved fatal." Van Swieten, in 1764, recorded the observation that frequently the most abundant discharges of lymph followed venesection; and Haller, a few years later (1773), stated that he had known a "flux of lymph of such long continuance, and so difficult to arrest, that he could explain its existence only upon the supposition that a large vessel" had been severed in blood-letting. Mascagni and Assalini, in 1787, cited cases of lymphorrhagia following venesection; the latter mentions the case "of a boy eleven years old who lost five pints of lymph in three days from a slight wound located upon the inner part of the thigh." Soemmerring (1795) and Monro also recorded observations of discharges of lymph following slight wounds; and Schreger (1799) mentions an instance of lymph fistula following blood-letting in the foot. Soemmerring remarks that the healing of wounds on the instep, near the ankles and knees, on the back of the hands, near the bend of the elbows, and near all joints, is impeded by the continual dripping of lymph, and offers the explanation that as the "absorbents about the joints are protected only by very thin skin and very little fat," the swelling and inflammation which ensue prevent contraction and compression of the incised vessels. In 1817 Nasse recorded several instances of lymph fistulæ caused by traumatic lesions of lymph vessels; in some of the cases he analyzed the fluid discharged and proved it to be lymph. Since then lymph fistulæ from traumatism seem to have attracted but little attention, though quite a large number of cases of lymphorrhœa and lymphorrhagia, occurring in consequence of diseased conditions of some portion of the lymphatic system, have been carefully recorded.

Even as late as 1859, Binet maintained that neglected lesions of lymph vessels would give rise to "ulcers of the most rebellious character," and suggests that ulcers of the lower extremities very frequently owe their origin "to alterations of the lymphatic vessels." Such ulcers may be recognized, says Binet, "by the abundance of the matter excreted, compared to the extent of the ulcer; by the increase of the excreted fluid when gentle pressure is made from the extremity towards the lesion; by the exceptional difficulty in cicatrization; and by the nature of the excretion."

Hewson relates the case of a butcher who cut some of the larger vessels which pass over the tibia, which was cured by compression. Monro also cites a case of copious discharge of lymph following the excision of a tumor from the upper arm, which was cured by the application of "Roman Vitriol."

Traumatic lymph fistulæ are generally found in the neighborhood of large joints, the ankle and knee joints being the most frequent localities.

The diagnosis is determined by the character of the fluid discharged.

Treatment.—Compression of the wounded vessels will usually be sufficient. Occasionally it will be necessary to make an incision into the cellular tissue round the wound or ulcer so as to cut off the fistulous tract from the lymph current. Cauterization or the application of iodine may sometimes serve a useful purpose.

Lymphorrhagia and Lymphangiectasis.

These conditions are so constantly associated as allied affections that it is proper to consider them together. Of the numerous cases that have been reported, both of the congenital and acquired forms, the following may be cited as instructive illustrations:—

Paterson reports the case of "a female infant, weighing seven pounds. Right leg

twice the size of the left; surface slightly purplish, with here and there a bluish tinge. The whole limb, from Poupart's ligament in front, and around by the crest of the ilium behind, down to the toes, was one mass of twisted and contorted varices. The vermicular prominences rolled round and round the leg in a singular manner, as represented in fig. 344.

"Motion was perfect, though obviously painful. The transpiration from the limb was so abundant and exhaustive that the child grew weaker from day to day. On the fifth day large blebs appeared on each side of the ankle, and the color and general appearance changed—it became darker; the copious transudation continued, the exhaustion increased, and death took place on the ninth day after birth.

Fig. 344.

Paterson's case of lymphangiectasis.

"Examination of the limb proved the varicose prominences to be enlarged lymphatics, filled to distension with a milky, serous fluid. From their abrupt beginning in front, around the buttock, and down the limb the lymphatics were twisted, corded, and rolled together. Around the crest of the ilium and along the course of Poupart's ligament the tissues were condensed, resembling tight bands stretched. There was no appearance of glandular or other structures. The muscles, glands, blood-vessels, etc., beneath were natural, and no distended lymphatics could be discovered in the deep tissues. The tissues from the iliac crest to the pubis seemed like a mass of hardened cellular tissue. No anastomotic connection between the superficial and deep-seated lymphatics could be discovered."

Day has reported the following case of a "boy, aged 7 years; healthy. When two and a half years old, the enlargement of the leg, which did not extend above the knee, and was most apparent above the ankle and on the inner and front aspect of the tibia, was first observed. The skin was normal, only tightly expanded over the tissues beneath, which was always increased by standing or walking. The limb gradually enlarged, and the tumefaction extended upwards, involving the entire thigh, until it measured as follows:—

	Inches.
Upper third of thigh	16
Middle of thigh	15½
Knee-joint	13
Below knee	12
Calf	11
Lower third of leg	11
Above ankle-joint	7¾
Instep	9
Base of toes	6½

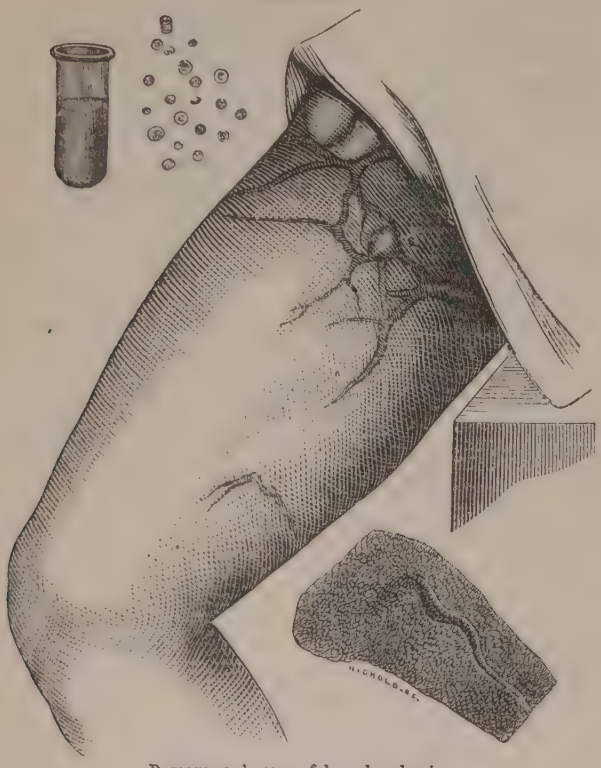
"When the system was out of order the leg always enlarged. During the period of growth herpetic spots appeared at various times on the leg, foot, and scrotum, and, when the leg had reached its largest development, a small pearly-looking vesicle appeared on the upper part of the penis, which finally ruptured and discharged, from time to time, a milky-looking fluid, which exhibited the following characteristics: Faint, sickening odor; salt-like taste; alkaline reaction. There was no uniformity in rapidity of coagulation. The clot bore the closest resemblance to that of blood, except being softer and destitute of red corpuscles. It contained a large quantity of fatty matter and fibrin, a molecular-base-like chyle, and numerous pale cells resembling white blood-corpuscles.

"A patch of yellowish-white vesicles, seeming to contain a cheesy matter, appeared on the upper part of the leg, and subsequent to the rupture of the vesicle on the penis, a cluster of similar vesicles appeared on the dorsum of the foot. The discharge was always followed by reduction in the size of the limb, and was sometimes so copious as to produce great debility, confining him to bed. Occasionally, after the disease had continued for several years, he was subject to attacks of inflammation limited to parts of the affected limb, which was attended with high fever, loss of appetite, burning pain, and redness of the part. Finally, in consequence of the recurring discharges, his general health became seriously impaired, characterized by great weakness and prostration. Sometimes the discharge in the beginning was pure lymph, changing, after it had continued for a while, into a chylous fluid exhibiting the characters before described."

Demarquay reports the case of "M. X., aged 17. Health always good. While playing, he noticed that a liquid, at first colorless, but soon acquiring a milky tinge, was flowing from a definitely located spot on the inner and lower part of the left thigh, where were found very small elevations in considerable number, and depressible. Some days after, M. Demarquay observed the liquid, at first almost colorless, with a slightly muddy tint, and passing to a yellowish-white, jetting with

considerable force from little granulations situated upon and around an elevation three or four centimetres in extent, depressible, and like a varix, extending in a slightly curved line from the anterior to the inner part of the thigh, as shown in fig. 345. This elevation became more evident upon walking, and diminished with rest. Several discharges took place during the following six months, and two months later, one which lasted nine hours. A portion of this was collected in a vessel, and soon coagulated like blood. In

Fig. 345.



Demarquay's case of lymphorrhagia.

the centre of the mass a clot formed, which appeared composed of a series of reddish filaments swimming in the midst of an abundant serum. M. Lebert declared the fluid to be lymph. Subsequent to this the varix increased in volume, and the little granulations before described became transparent vesicles, which, when pricked, discharged copiously a similar fluid. Another series of vesicles appeared on the anterior surface of the same thigh, and in the groin there was a small venous varix. The affected thigh increased in size in excess of the sound limb. In this case there was dilatation of a lymphatic vessel, and also of the superficial network, in two well-defined points of the thigh. The boy continued to lose large quantities of lymph without any impairment of his general health. Compression above and below the point from which the lymph flowed gave rise to a jet of appreciable duration; pressure below did not arrest the flow."

Thilesen's case exhibits special peculiarities: "F. N., aged 19 years. When one year old the right thigh was larger than the left, more or less so according to the use of the limb. When four years of age, after a short walk, without unusual exertion, the right thigh was observed to be double the size of the left. The swelling extended from the groin to the knee, was not sensitive or painful, and was covered with normal-colored skin. It remained, now larger, now smaller, but occasioned no inconvenience. After a while the skin upon the anterior and inner aspect and towards the scrotum thinned in several places, forming small shining spots slightly elevated, which ruptured spontaneously and discharged a yellowish-white, opalescent, somewhat tenacious fluid, which, upon exposure to the air, coagulated into a jelly-like mass. When the rupture occurred while walking, the fluid would jet out for several feet, and sometimes a pint or more was lost, which would be followed by a sense of great exhaustion, paleness, and languor. These discharges recurred three or five times during a year, and continued for thirteen years, during which time the swelling extended to the leg and foot, and similar thinned

spots formed upon the plantar surface and between the toes, but none appeared upon the leg. When ten years old, without discoverable cause, violent pains around the right trochanter, extending across the right gluteal region and down the thigh and leg, supervened. At the same time, the extremity from the groin to the sole of the foot began to enlarge more rapidly, the thigh attained the circumference of the body of an adult, and the foot and leg increased in proportion. Subsequently a large abscess formed in the gluteal region, which after a time ruptured and discharged during several months large quantities of pus, and after it healed the thinned spots developed into transparent vesicles the size of peas, containing a clear liquid; the integument thickened and felt firmer, the epidermis roughened, the furrows deepened, and the papillæ enlarged. The limb enlarged throughout its whole length, and numerous vesicles formed upon the anterior and inner surface of the thigh, and upwards towards the groin and scrotum, reaching one and a half lines in height, transparent, and filled with a watery fluid. The contained fluid could be pressed back, but immediately returned upon the removal of the pressure. One of the larger cysts was opened, and the evacuated fluid proved, on microscopic examination, to be lymph. Finally, pleuritis set in, and the patient died.

"*Autopsy.*—Skin hypertrophic throughout all its layers; more so upon the anterior and inner part of the femur. Throughout the hypertrophied portion was a large meshy net of dilated lymph vessels, some of which had attained the size of goose-quills. The most superficial vessels could be traced into the cysts projecting from the skin, and they were ampulla-like dilatations of the extreme ends of these vessels, with thinning of their walls. Upon the lymphatic trunks situated outside of this extremity, nothing abnormal could be discovered. The lumbar muscles were atrophied. The connective-tissue of the lowest portion of the leg was infiltrated with pus, the articular cartilage of the lower end of the tibia was destroyed, the ends of the bones carious, the ligaments destroyed, tarsal bones carious. Tubercular deposits in both lungs, beginning to soften; small caverns in left lung. Tubercular deposits in liver, spleen, and other abdominal organs."

Of the acquired forms the following are illustrative cases:—

Hilton's case was "a laborer, aged 22. Right thigh began to swell a year previous to admission to hospital, first at the upper part and then gradually downwards to the toes. Skin not changed in color; no pain in the part. Small openings appeared about the middle of inner side, from which a milky fluid exuded every three or four weeks, and his leg and foot began to grow and became very firm. Before admission the thigh was enlarged throughout its whole extent, and since, the scrotum and penis became involved in the swelling. Left leg quite natural; appearance strumous; dissipated. The right leg is one-third larger than the left, of natural color and temperature; imparts to the touch a feeling like a female mamma distended with milk. There was a sensation of hard, irregular cords, lying in a brawny structure. No œdema. Towards back of thigh, and scattered over the lower half of its extent, were numerous vesicles, varying in size from a pin's head to that of a pea. No redness surrounded them. From them the milky fluid was discharged, and when tapped it exuded drop by drop. The fluid separated on standing into a rounded coagulum, smooth and shining, and a watery looking fluid. It contained bodies resembling lymph corpuscles, granules, and fatty molecules, albumen, fibrin, but no sugar."

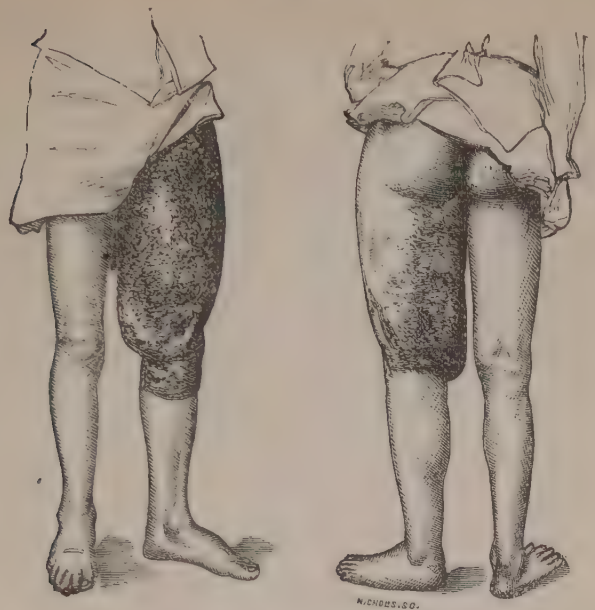
In Jackson's case the first unusual circumstance was the formation of an abscess on the lower part of the belly.

"It extended from one superior spinous process of the ilium to the other; and left scars, one in the median line two inches long, and about two inches above the level of the median line, and two minor ones on the left side about the same level. The abscess discharged abundantly, leaving the boy extremely weak. Two or three days after the abscess got well, the left thigh began to swell from knee to groin. This enlargement steadily increased, and at the time of the observation the left limb was enlarged in its whole circumference, being much arched in front; it does not taper off towards the knee, on the inner side, like the healthy thigh; but the tissues just above the internal condyle of the femur are so very much hypertrophied as to widen out this part of the limb greatly. The swelling is well defined by Poupart's ligament above.

"There was a notable difference in color, and some redness, in part due to straining, in part to actual congestion, and a much larger amount of hair on this as compared with the healthy limb. The inner and front aspects of the thigh were dotted over closely with a pustular eruption in the stage of crusting. Over a space which would be covered by the palm of the hand there were groups or clusters of white points, about the size of a millet-seed, containing opaque fluid. On closer examination smaller ones were to be seen scattered all over the thigh, suggesting to the mind varicose lymphatics filled with lymph; on puncturing them a milky fluid exuded, which coagulated, and, under the microscope, exhibited all the characters of true lymph. Delicate raised tortuous lines could be detected, which were produced by some distended vessels, running in a serpentine direction, and which were due to hypertrophied lymphatics. The pustular eruption resulted from inflammation of the distended lymphatics, at the prominent points."

"The limb felt elastic and firm, and the irregularities were more apparent than real; still there was more hardness in some places than others. The surface was cool; the swelling was freely movable over the femur; and if any one part was handled, the whole moved. There was no tenderness or enlarge-

Fig. 346.



Jackson's case of acquired lymphangiectasis.

ment of the glands in the groin, and not a trace or vestige of varicose veins or œdema of the limb. The tortuous lymphatics occasionally burst naturally, and discharged freely. The limb had decreased considerably since the lymphatics disgorged their contents from time to time."

Buchanan reports the case of a woman who for a number of years discharged a white fibrino-serous fluid, in varying quantities, at irregular intervals, from a semi-excoriated surface situated on the inner and posterior surface of the left thigh, which was thickly covered with white pearly vesicles, from the size of a pin's head to those met with in herpes zoster. The discharge ceased during three successive pregnancies, to be re-established immediately after the birth of the child, though during lactation it was neither so copious nor so continuous; and on one occasion, when neither pregnant nor nursing, a brownish-yellow, pus-like fluid was squeezed from the tender and swollen mammæ, which, under the microscope, exhibited a "multitude of minute oil-globules, with a few well-marked colostrum-corpuscles. The fluid varied in physical characters, sometimes milk-like, at others serous and opalescent." Its milky appearance increased with the duration of the flow, and sometimes in odor and color it was indistinguishable from pure milk.

Symptoms, Causes, and Diagnosis.

In a large majority of the cases of lymphangiectasis and lymphorrhagia the fluid, which either accumulated in the affected area, or was emitted through the ruptured or incised vessels, presented the physical characteristics and appearance of chyle, due to the quantity of fat it contained. In a few cases the fluid which was at first discharged, or which was collected in the vesicular formations, was serous and gradually changed into a chylous or milk-like fluid. In several instances this change in the color seemed to be immediately connected with the digestion and assimilation of food. In Roberts's case the vesicles varied in color and fulness. The whiter they were, the more distended, and when pale they were flaccid; when feverish they were pale, but when the appetite and sleep returned they became milky and turgid. They were pale before breakfast, and full and white soon afterwards.

Desjardins insists that the specimen obtained by him, from a patient affected with varicose dilatation of the superficial lymphatic network of the derma of the left thigh, presented all the characteristics, both chemical and microscopical, of perfectly pure lymph. The fluid was emitted involuntarily at irregular intervals from translucent phlyctenulæ, having the aspect and size of grains of boiled sage, resulting from the dilatation of the superficial integumentary lymphatic network, which were in direct communication with ampullæ, which seemed to be the reservoirs for the accumulated fluid. It usually escaped guttatim, and in one instance reached in quantity 5½ lbs. in 24 hours. In Demarquay's case the fluid was ejected from a minute vesicle, was at

first colorless, and acquired during its continuance a milky tinge. The change in color occurred during every emission.

The vesicular formations, variously described by different writers as ampullæ, bladder-like sacs, or cystic degenerations of the terminal ends of lymph-channels, are phenomena very constantly associated with lymphangiectasia and lymphorrhagia. These dilatations of the lymph plexuses of origin, as they are denominated by Binet and Aimé-David, are more or less prominent, hemispherical, usually transparent, not always depressible, varying in size, in the beginning not often exceeding the size of a pin's head or a lentil, and enlarging at a more advanced period, but not often projecting more than a line and a half above the cutaneous surface. The larger the vesicles, the more markedly ampullar, forming sacs with constricted necks. They often rupture spontaneously, and are always easily perforated with a pointed instrument, discharging a slightly alkaline, viscid fluid, having a milky color, and varying in quantity, sometimes escaping in a continuous stream, at others drop by drop, or in a jet. The quantity discharged may be increased by the erect posture, by movements of the neighboring muscles, or by pressure along the course of the connecting lymph-vessel. When the body is in a horizontal position they usually diminish in size or fulness, and, if ruptured, cease discharging. The fluid evacuated stiffens on cooling, coagulates on exposure to the air, and is chemically and microscopically analogous to lymph. Cruveilhier encountered pus several times in ampullar lymphatic varices, and others have occasionally found a fluid more or less mixed with blood and other extraneous matters. When depressible the vesicles retake their form upon removal of the pressure. These ampullar dilatations of the terminal extremities of the capillaries, or more properly of the lymph spaces, are usually found in groups of closely aggregated vesicles, though not observing, as maintained by several authors, any definite order of arrangement. They have a predilection for localities rich in the superficial plexuses, and where the trunkal vessels are more developed and so disposed as to suffer distension from accumulation of lymph, such as the upper anterior and posterior surfaces of the thigh, malleolar regions, anterior abdominal walls, scrotum and prepuce. When at their most advanced development they allow the lymph to flow from one to another, and are always associated with dilatation of connecting subcutaneous vessels, which may be cylindrical in form, feeling like hard, knotted, flexible, mobile cords, or moniliform, seeming to be constituted of a series of little bladders placed one following the other, or they may communicate with a lymph cavernous structure lying beneath. When the vesicular formations are covered with the cutis, they may develop to the size of a male or female nipple, or even larger. When beneath the skin, involving the subcutaneous vessels only, they are usually much larger, and feel like rounded tumors, more or less voluminous, but not adherent to the skin. In Paterson's case, a cyst-like protuberance formed during the lifetime of the patient, which proved on examination to be a conglomerate formation of varicose lymphatic channels. In the cases of Amussat, Drinkard, and Fetzer, the tumors, mistaken for herniæ, consisted of a congeries of dilated and distended lymph vessels, so interwoven as to convey the sensation of sacs.

Lymphangiectases assume a variety of forms. Lebert divides varices of the lymphatics into three forms: 1st, groups of closely aggregated vesicles; 2d, more voluminous ampullæ connecting directly with neighboring vessels underlying cylindrical dilatations; and 3d, varices of regions of vessels forming a mass of dilated vessels. Cruveilhier divides them into two varieties—the ampullar, and cylindrical or non-circumscribed varices. This division is only applicable to the varices of the vessels of the lower extremities, and are analogous to the forms of venous varicosities, though less frequent—their infrequency being due to the absence of any propelling organ, to the greater resistance of the vascular walls to the lateral pressure of the fluid, to the resistance offered by the valves to a reflux current, and to the static force of the superimposed column of fluid. Aimé-David makes two divisions—the traumatic and spontaneous; the latter being exclusively confined to regions rich in the distribution of vessels and plexuses.

Among the congenital cases there are illustrations of several varieties. The moniliform, in which the integrity of the valves is preserved, gives the vessel a knotted, rosary-like form, as if constituted of a series of bladders placed one by the side of the other. When exaggerated the vessel becomes cylindrical, which involves valvular insufficiency. This form may be limited to a part, or to a single vessel, or may involve a number of neighboring vessels, presenting the character of sac-like tumors, or may extend to the vessels of an entire limb, and as in Amussat's case, an extensive region of internal vessels may be implicated.

Demarquay's case was characterized by a series of little depressible vesicles grouped

around each other, which developed slowly and spontaneously, were enlarged when walking, and diminished when at rest. The lymphorrhagia commenced during active and perhaps violent exercise, when the accumulation of lymph became excessive, consequent upon active muscular movements, and stasis occasioned by occluded vessels or impermeable glands. Valvular insufficiency existed, either as a congenital defect of formation, or resulted from excessive vascular distension, and a reflex current ensued. The walls of the vessels were gradually thinned, the ampullar dilatation developed slowly, and rupture followed.

No less remarkable, and even more instructive, is the case of Thilesen. A boy, aged 19, had from infancy a perfectly painless tumor of the skin, sharply defined above by Poupart's ligament, and extending downwards towards the knee. After a time the skin, especially upon the anterior and inner aspects of the thigh, towards the scrotum—a region rich in lymphatic networks and anastomoses—thinned in places, presenting small, shining, slightly elevated spots. These spots, when ruptured, either spontaneously or by violent effort, discharged a yellowish-white, opalescent, coagulable fluid. Subsequently the enlargement increased and extended downwards, involving the leg and foot, and many of the former thin-skinned spots developed into transparent vesicles, distended with fluid. Similar thin-skinned spots formed upon the foot, especially upon the plantar surface and between the toes. Beneath the thickened, firm, compact integument covering the inner surface of the thigh, in the region where the varices were most abundant, several deep-seated, hard cords could be distinguished. The varices, either in the form of shining spots or distinct and elevated vesicles, were only found in regions of the thigh where finely meshed lymphatic networks are distributed through the integument.

The slow and spontaneous development of the wart-like tumors in Fetzer's case, the effacement of the prominences by pressure, their locality in a region rich in plexuses, the reflux current from one to another, their grouping together, their thin integumental covering, the easy introduction of a probe to the right or left, and the character of the fluid discharged, establish the connection of the varices of the superficial integumental plexuses with ectases of the deeper-seated vessels, and points to congenital defect of the terminal extremities of the lymph-channels. The suggestion of Aimé-David, that the lesion resulted from the pressure of stays upon the abdominal parietes, is hardly tenable in view of the fact that the superficial lymphatics of the abdominal walls are in connection with the inguinal glands. The communication between the ampullar dilatations and the lymph cavernous structure beneath was demonstrated to be continuous and direct; but in Roberts's case they were not intercommunicating, though depressible, and seemed to be connected with a deeply-seated reservoir of anastomosing channels. The thickened skin and subcutaneous tissue were traversed by short channels or lacunæ, which seemed to communicate with each other by small, smooth orifices. The nipple-shaped bodies and the vesicles constituted the surface boundaries of the more superficial lacunæ. When the accumulation is confined or extends to the canaliculi of the skin, gradual thinning of the epidermis takes place in consequence of the continuous presence and constant oscillation of the fluid, eventuating in the formation of vessels, projecting above the surface. The lymph-canalicular system is without valves. Ectasis might thus ensue, either from stasis resulting from occlusion of neighboring trunks, or from impermeable glands, or from the constant oscillation of the fluid due to congenital defect, or to absence of valves in the capillaries. Odenius, in a case of lymphorrhagia pachydermia, found distinctly marked open ducts leading through the bases of the papillæ into the superficial lymph network, and beneath the surface of the cutis he found wide, canal-like caverns or cavities, from which branches extended upwards towards the papillæ and downwards into the deeper tissues of the skin. Teichmann found in the skin of an elephantoid leg, the papillæ supplied with lymph vessels, extending generally from two-thirds to three-fourths of their length, usually dividing near the bases of the papillæ into two vessels, which emptied into the superficial network. It cannot be doubted that the vesicle formations in the case of Odenius, and probably also of Teichmann, were connected, through open canals, with lymph-vessels, for the vesicles characterized themselves as true lymphangiectases; but it cannot be maintained that all lymphatic vesicle formations are ampullar dilatations of newly-formed lymph vessels, which have by gradual and continuous development penetrated the papillæ of the skin. In many cases they are true ectases of the serous spaces or lymph radicles of the integument. The cases of Odenius and Teichmann were associated with inflammatory processes, and the vesicles were immediately connected with the inflammatory changes. Recurrent inflammation of an erysipelatous or elephantoid character is quite frequently associated with lymphorrhagiæ and lymphangiectases.

C. Handfield Jones has reported three cases of "dilatation of lymphatic radicles," which presented a plexiform arrangement of freely intercommunicating vasoid spaces, lying immediately beneath the epidermis, seeming to groove the corium, and disappearing at the localities where the superficial vessels passed

into the tissues to unite with the deeper lymphatic vessels. No vesicles were present.

The cases of lymphorrhagia and lymphangiectasis frequently coexisted with venous telangiectasis of the skin, dilatations of the superficial veins, lipomata, and diffuse proliferation of the adipose and connective tissues. In Day's case the overgrowth was ascribed to the retention of lymph in the affected parts. So far as the observations can be relied on, the cases of Day, Demarquay, and Hilton, in which similar phenomena were present, though in the last case the condition was acquired, the direct relation of lymph-stasis to increased growth was established, for in each case the chemical and microscopical examinations of the fluid leave no doubt of its nature; but the case of Thilesen is even more conclusive.

The continued presence and increased growth of the tumor in the latter case, often varying in size, and unaccompanied with change of color, pain, or sensitiveness, exclude any possibility of the presence of either acute or chronic hyperæmia, and the absence of any lesion referable to the blood-vascular system excludes any connection of the enlargement with venous stasis. On the contrary, the presence of meshes of dilated lymph vessels, their direct communication with the cutaneous vesicles, the development of the cicatricial spots into vesicular formations, and the rapidity of the growth in those parts most abundantly supplied with capillary lymph vessels, and, furthermore, the first appearance of the swelling in the region very rich in networks of lymph capillaries, show conclusively that the alteration of the nutrition of the parts was due to some defect in the lymph-circulation. The swelling followed the course of the large superficial lymphatic branches, ascending from the foot and leg and running along the vena saphena, and of the lymph-vessels proper of the thigh, emanating from the rich network upon the inner and posterior aspect, and penetrating the entire tissue of the integument down to the fascia; and also those sending branches upward towards the superficial inguinal glands, and encircling the inner and external half of the thigh. The cases of Day, Hilton, and Thilesen were unaccompanied with any inflammatory process, œdematous infiltration, or phlebectasis; but in Paterson's case, which differed in so far that the varicose lymph-vessels were on the surface of the extremity, and could not be traced in anastomotic connection with the deeper-seated vessels, there was a profuse transudation of a watery fluid. There was no lesion of the bloodvessels. The fluid was lymph, but poor in nutritive elements, and the only change observed in the tissues was hardening and condensation in the cellular tissue in circumscribed localities.

In Thilesen's case the changed growth was without inflammatory concomitants, and manifestly due to the retention and altered elaboration of lymph. A serous infiltration may be caused by hydræmia, mechanical impediment to the circulation of the blood, especially in the veins, or by defective absorption. In either case a change in the nutrition of the parts may ensue. The formation of the vesicles, the development of the cicatricial spots into vesicles, the lymphorrhagia, the chemical and microscopical characters of the discharged fluid, and the post-mortem appearances leave no doubt in regard to the lymphangiectasis, but other conditions were present during the progress of the case, which Thilesen insists are sufficient to determine the presence of a lymphatic varix. Phlebectasis is excluded by the absence of pain, of dilatation of the superficial veins, and of changed color along the varicose veins, and of a single hard cord along the course of the affected vein; by the non-appearance of œdema in the neighborhood of the ankle and on the dorsum of the foot during the earlier stage of the disease and its gradual extension upwards. The infiltration in phlebectasis results from increased transudation in consequence of increased blood pressure in the venous radicles and their dilatations, or from interrupted venous circulation. The accumulated fluid is consequently watery, poor in solid constituents, and the resulting swelling would present all the characteristics of ordinary œdema. Absorption may be normal, or perhaps increased, and with rest of the affected limb the intumescence would probably disappear entirely, or diminish. In consequence of the poverty of the fluid the changes in nutrition are very slow, and the enlargement partakes more of the nature of an anasarca than of an hypertrophy; and finally, phlebectasis is usually connected with some constitutional affection or distant local disease, and attacks the most distal parts, where the circulation is least supported by the muscles. Lymphangiectasis is usually found in circumscribed localities, where the networks of lymph-capillaries are most numerously distributed. The swelling is more diffused, not in the form of single hard cords, is more resistant, and the surface is unchanged. It usually extends downwards, and is not so much influenced by continued rest and by the posture of the affected limb. In lymphangiectasis there is also an accumulation of fluid, resulting from diminished absorption or interrupted lymph-circulation. The fluid consists of the normal pre-existing paren-

chymatous fluids, the nutritive juices, continually conveyed thither, and partly of the fluids consumed by the functions of the parts and saturated with organic débris. It is, however, more abundantly supplied with organic elements, as well of progressive as of retrogressive metamorphosis, with albumen and fibrinous substances, than the accumulated fluid in phlebectasis and ordinary œdema. The tumor, therefore, says Thilesen, "offers characteristics from the beginning different. Formed of a more consistent, coagulable, and partly organizable material, it possesses greater consistence, is nearly compact to the touch, which will increase as the fluid undergoes peculiar changes during its retention in the parts." The development is peculiar, not altogether unlike phlegmasia and scleroma, and similar to Virchow's lymphatic hydrops, which more frequently than the ordinary œdematous fluid, if indeed, this ever does, becomes inspissated and is assimilated, leading to hypertrophy. Thilesen attributed the pus-formation to over-distension and accumulation of organizable material without corresponding power of assimilation, whereby a large part of the mass remained in a lower degree of development, in the form of pus-cells. The pus collections necessarily partook of the nature of cold abscesses, and were located in the connective tissue. This, he also maintains, constitutes another distinctive feature of the case, for pus formation in phlebectasis usually begins in the coagula formed within the varicose vein, is associated with acute symptoms, and may result in purulent absorption.

Most of the cases of lymphangiectasis and lymphorrhagia are subject to frequently recurring attacks of inflammation. This tendency is not so universal among the congenital as among the acquired forms, due to the fact that in the former the affection frequently finds its cause in some defect of formation of some part of the lymphatic apparatus, whereas in the acquired forms, the immediate cause is generally traceable to structural changes produced by previous inflammation—traumatism or thrombosis. There is no doubt that in the congenital cases malformation is the most frequent cause; yet it is not improbable that morbid processes taking place during intra-uterine life have produced the various forms of occlusion, dilatation and narrowing of lymph channels, and it is not improbable that the inflamtory processes which subsequently during extra-uterine life invaded the affected parts, were merely recurrences of similar morbid conditions which had attacked the parts prior to birth. However different the morbid processes may have been, the structural alterations are the same. Quincke insists that inflammation and lymph thrombosis are the pathological processes which usually cause circumscribed narrowing or complete occlusion of lymph channels. These conditions may be caused by thickening of the coats of the vessels, adhesion of their internal surfaces, fibroid transformation or calcification of their coats, thrombi, compression from cicatrices, induration of surrounding connective tissue, tumors, diseased glands, stasis of blood in large veins, cardiac diseases, or mechanical obstruction to the lymph stream.

Treatment.—The treatment is properly divided into local and constitutional. The latter properly relates exclusively to the anæmia so constantly resulting from the losses of lymph, and prophylactic measures to obviate the manifest tendency to the development of tuberculous affections. In a few cases constitutional treatment has apparently, for a time, promised favorable results. Thilesen administered bitter tonics, but his patient died of general tuberculosis. In Day's case there was apparent improvement for two years under the use of cardiac stimulants, warm clothing, frictions, the internal use of iron and other tonics, moderate exercise, and recumbency when at rest. Mr. Maunder insists that the hypertrophy is consequent on an undue supply of nutrient material, and that the indication is to diminish the supply either by compression or ligation of the principal artery supplying the affected limb or part. Various methods of constitutional treatment have been attempted, but all have proved valueless, when addressed to the arrest or diminution of the local hypertrophies. An appropriate treatment by tonics, diet, and hygienic measures is not without hope in delaying the development, or staying the progress of the tuberculous complication.

The lymphatic anæmia which Lebert classes among the spoliative forms, and which is usually the immediate effect of the lymphorrhagia, has been usually successfully treated with rest in the recumbent posture, a nutritious and easily digested diet, and tonics. Usually the discharge will cease after a few hours' duration, but occasionally interference becomes imperative, because of the copiousness of the loss, and consequent impairment of the constitutional vigor. A compress applied firmly to the aperture, or cauterization, has frequently been sufficient to temporarily arrest the flow, but sometimes these expedients have failed. Occasionally elevation of the affected limb has arrested the discharge. Fetzer failed with compresses, astringent solutions, and cauterization, but finally succeeded by painting the surface with a strong solution of the "lapis infernalis." Aimé-David in-

sists that caustics are only admissible when the lesion is confined to the plexuses of origin, and that the nitrate of silver is preferable to all others. He asserts that the radical cure of these affections is very doubtful, and that lymphangitis, which is such a frequent complication, and usually so rapidly fatal, is always to be apprehended from the use of caustics, or other surgical expedients. Carter was unsuccessful with large doses of gallic acid.

Roberts treated his case with styptics of various kinds, especially tannic acid, which was given in large doses. Locally, compression was attempted by means of long wide strips of adhesive plaster, but without any good effect. The discharge moistened and loosened the plaster, and the soft, yielding nature of the abdominal walls rendered impossible any effective compression by bandages or belts. Attempts were also made to varnish the surface with a solution of India-rubber in vinegar, and with collodion, but every device proved unavailing.

The ancients employed without benefit, a great variety of topical applications. Muys, Nuck, Haller, Bell, and others secured fair results from caustics only after long continuance. Solingen employed with success direct compression, and in one case he practised with success scarification about the aperture, and the actual cautery. Ruysch first suggested compression below the aperture, which Kerkringius, Nuck, and Assalini tried with success. Bell employed compression, and proposed ligation of the vessels. Methodical compression, says Binet, below the lesion, along the course of the ruptured vessel, seems, when practicable, to be the best method of controlling old and recent discharges. When this fails, deep and energetic cauterization may be employed to destroy a part of the altered vessel, or to produce local inflammation sufficiently intense to obviate the fistulous orifice.

When a limb is affected, compression must be made by the application of a bandage to the entire member, or when it is a lower extremity, by an elastic stocking or bandage. Sometimes compression may with advantage be combined with rest and elevation of the affected limb. It does not at best promise more than temporary benefit, and is not entirely free from danger. Unless it is equable over all parts of the affected limb it will occasion much discomfort, and fails to effect any good, for the fluid will accumulate in localities where least or no pressure is made.

The management of the frequently recurring attacks of erysipelatous inflammation, to which these affections are so liable, does not differ from the ordinary treatment of erysipelas.

Lymphangioma.

Lymphangioma may be either congenital or acquired. Wegner has divided the congenital forms into three classes, as follows :—

I. Lymphangioma simplex, consisting of lymph spaces and capillaries forming an anastomosing network. He illustrates this variety mainly by cases of macroglossia. To this class also belong the cases of macrochilia, except such as Billroth insists consist exclusively of a fibroid development, and those which Weber maintains are merely an hypertrophy of the muscular tissue, having its beginning in some obscure inflammatory process.

II. Lymphangioma cavernosum, consisting of trabeculæ of connective tissue inclosing cavities filled with lymph.

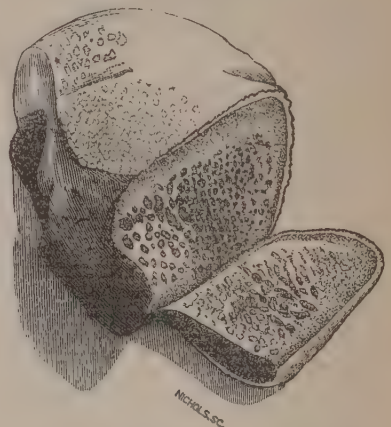
III. Lymphangioma cystoides, consisting apparently of a collection of cysts, which are, however, not true cysts, but lymph spaces.

Simple lymphangioma, which is exclusively a congenital form, may be illustrated by the following cases of macroglossia and macrochilia.

"A child, two years old, had, from birth, a thick tongue, which had greatly increased during the preceding two weeks. The tongue protruded from the mouth in a broad, thick, hard mass, and was closely encircled by the stretched lips.

"Upon the posterior under surface lay, in partly bead-like rows, bluish transparent vesicles, varying from very fine, just visible bodies, to the size of large flaxseeds.

Fig. 347.



Lymphangioma of tongue (macroglossia).

"Upon longitudinal section through one lateral half of the ablated portion, the cavernous tissue was found principally in the middle part corresponding to the region of the transverse muscle, as shown in fig. 347.

"Upon the top could be distinguished the whitish, tough layer of the mucous membrane and the papillæ; below it a longitudinally striated, very tough, and whitish layer; next, the cavernous mass, and below, again, a more longitudinally striated layer, which continued beyond the apex. The same result was found upon tranverse section, and the cavernous structure appeared in the centre in very coarse meshes, whilst towards the lateral portions it became fine, and towards the periphery the mesh cavities became smaller and smaller in such a manner that bead-like vesicles could be traced up to the papillæ. The cavities were elongated perpendicularly, and varied in size from the smallest, barely visible points, to over one line in their greatest diameter. The width of the trabeculæ varied. Many of the cavities communicated by narrow openings; many, however, appeared closed, and the adjacent vesicles could be seen shining through at the bottom; the trabeculæ and partition walls which bounded them were sharply defined, more or less smooth, and pale."

"C. R., aged fifteen, was born with a thick upper lip. He often suffered with swelling of the glands of the neck during childhood, without suppuration ever taking place, and several times the upper lip had been inflamed and much swollen, which had subsided, leaving only an increased enlargement of the lip.

"The excised portion collapsed very much and showed to the naked eye a distinct cavernous trabecular tissue, and a lymphoid serous fluid could be pressed from the deeper caverns, while coagula were found in the smaller caverns. The trabeculæ were formed in part of connective tissue only, in part also by fibres of the orbicularis oris; the largest cavities were of the size of small peas, the smallest microscopic."

"E. S., aged seven months, suffered from congenital macroglossia, which about every four weeks was attacked with some inflammation, attended with difficult deglutition, dyspnœa, and considerable enlargement of the neighboring lymphatic glands. The volume of the tongue was increased after each attack, finally attaining the size of an ordinary apple, felt very tense to the touch, was dark red; its surface was covered with a thick, white coating. The strongly developed papillæ gave to the surface a thickly villous, furry appearance.

"The protruding portion was amputated, and on examination its parenchyma was found to have degenerated into a cavernous meshwork, whose trabeculæ were partly formed of white, firm connective-tissue cords, partly by muscle-bundles. The fluid within the meshes of the cavernous tissue coagulated into very white coagula, which looked like fibrin coagula, and consisted of lymph-corpuscles."

Virchow insists that the "bead-like, bluish, transparent vesicles, which varied in size from just visible bodies to the size of hempseed," found on the under surface of the ablated portion of the tongue, were dilated terminal lymph spaces, and communicated by very fine apertures with deeper-seated vessels, or with the cavities of the cavernous tissue of the parenchyma. For, notwithstanding this connection could not be demonstrated, it could be shown that the cystoid spaces, probably dilated lymph-canaliculi, became smaller and smaller towards the surface, and, finally, bead-like vesicles could be traced up to the papillæ. The characteristics of the cavities with which the hypertrophied portions of the tongue were interspersed, can only be explained upon the supposition of the primary ectases of lymph-channels. In Billroth's case of macrochilia, cavernous trabecular tissue was distinctly visible to the naked eye, from which a lymphoid fluid could be pressed, and in the other case, he found a cavernous transformation of the parenchyma containing a lymphoid fluid. Neither Billroth nor Virchow succeeded in establishlishing a direct continuity between the caverns and lymph-capillaries, but the microscopic character of the fluid was sufficient. In one of Billroth's cases of macrochilia, it was not possible to distinguish the fluid from lymph, and in the other it consisted of lymph-corpuscles and fibrin. Virchow maintains that the cystoid formations found in the nodes of congenital hypertrophies, are formed by the dilatation of the lymph-spaces, though their communication with lymph-vessels may not be recognized. Billroth, though holding that congenital macroglossia and macrochilia may be either solid or cystic, concedes that the cysts owe their origin to occlusion and dilatation of lymph-channels; and O. Weber asserts that congenital lymphangi ectases of the tongue and lip find their cause in dilatation of the final terminations, or, more correctly, of the origin of the lymph vessels.

Billroth coincides with Virchow, that in such conditions as were found in the cases of C. R. and E. S., a cavernous ectasis of lymph-vessels was the primary and predominant condition, but he differs from Virchow in the opinion that all cases of congenital macroglossia and macrochilia find their cause in ectasis of lymph vessels and spaces, and holds that in some cases the hypertrophy was solely a fibroid development.

Broca regarded the lesions in a case in which the tumefaction involved the base of the nose and lower part of the forehead, as closely comparable, if not identical, with those presented in the case of macroglossia reported by Virchow. In the latter case, the lacunæ varied from points scarcely perceptible to cavities measuring more than a line; many of the cavities communicated by minute openings in their intervening septa. According to Virchow the cavernous structure depended on the simultaneous dilatation of the lymphatic vessels and of the plasmatic channels in communication with them. Sappey rejects any hypothesis involving distension of the serous canaliculi of the connective-

tissue, but admits the ectasis of the vessels. Broca suggests that the cavernous condition may be produced by the dilatation of lymphatic vessels, which "elongate themselves, become tortuous, return upon themselves in the form of clusters comparable to little bladders united to each other," and by the thinning and rupture of their walls become transformed into lacunæ. Some of these lymphatic varices undergo a polycystic transformation, which some have attributed to obliteration of the vessels, but Sappey denies this and insists that the ectasis is due to a primary lesion of the walls of the vessels, which diminishes resistance and elasticity, and which "depends on a general influence as unknown as that which presides over the formation of venous tumors."

The following cases of Reichel and Gjorgjewic will sufficiently exhibit the anatomical characteristics of the cavernous variety.

"A. W., æt. one year and five months, had a congenital tumor of the size of a pigeon's egg, of hard consistency, situated to the left of the perineum in the immediate vicinity of the scrotum. At the time of the observation the tumor had grown to the size of an infant's head, and extended from the scrotum attached to the left of the perineum, to behind the anus, sending the principal mass towards the left tuber ischii; it looked like a third buttock. The primary portion had grown but little, and felt hardish, whilst the new growth felt more like a lipoma or cavernous growth, and formed the principal part of the mass. The child was otherwise healthy, ate, drank, and possessed all the normal functions.

"*Microscopic examination of the ablated portion by Professor Waldeyer.*—It consisted, for the greatest part, of normal cutis, with subjacent, perhaps an inch thick, fat connective-tissue cushions. The fat clusters, however, were but little developed; the interstitial connective tissue was more prominent, and formed in spots tolerably firm, but always elastic, yielding masses. In the place of the fat cushions, single, mostly pea-size clear cysts, with thin walls, were seen lying in the connective-tissue meshes. In the large integumentary portions one of the cysts attained nearly the size of a walnut. The smallest looked like beads, clear as water and of pin's-head size."

"A female, aged nineteen. At the age of nine, while playing, was suddenly attacked with severe pain in the left groin, attended with redness and accompanied with vomiting and chilliness. These attacks recurred thrice a year until four years ago, when a number of small vesicles formed upon the inner side of the thigh, which ruptured spontaneously, and have continued to discharge a clear fluid. At the present time (July, 1869), a tumor, about the size of a fist, indistinctly defined and perfectly soft, is situated upon the inner side of the left thigh, below Poupart's ligament. The covering integument is traversed by several dilated vessels supplied with several openings, from which a fluid can be expressed, which coagulates into a transparent, pale jelly. Instead of a cold abscess, Prof. Billroth found a cavity of fine mesh-work, from which the fluid exuded, which proved to be of a lymphatic character.

"*Microscopic examination of the extirpated tumor by Czerny.*—The principal bulk of the tumor consisted of connective-tissue trabecular mesh-work, which contained lymph in its interstices. The walls of the lymph-caverns were lined by endothelium. Here and there, especially in the periphery, the connective tissue was richly infiltrated with cells, and columns of young cells passed into the surrounding tissue which were connected with lymph-vessels. The tumor seemed to owe its origin to the development of granulation-tissue around the lymph vessels, which, by cicatrization, produced ectasis of the vessels, and thus led to the formation of a cavernous lymph tumor."

Winiwarter observed a case of macroglossia combined with cystic hygroma, in which the tumor upon the neck consisted of several large cysts which penetrated between the muscles of the floor of the oral cavity, and passed into the cavernous tissue of the tongue. He believed that a portion of the caverns originated from dilatation of pre-existing lymph vessels, but that a majority were developed by division of the connective-tissue cells. Weichselbaum suggests another mode of development. The follicular proliferations become saturated with serum, "their cells are forced apart and in part disintegrated, while the supportive tissue with its mesh cavities remains; finally, this also disappears, and the small mesh cavities unite into larger caverns." Czerny reached the conclusion that cavernous spaces were formed from granulation-tissue which developed around lymph-vessels. Various theories concerning the origin of cavernous tumors have been suggested, but the question remains unsettled. Rindfleisch asserts that every tissue supplied with bloodvessels can be transformed into cavernous tissue, the only prerequisite being the presence of germinal tissue.

Billroth, Lücke, Köster, and others, have classed the congenital cystic hygroma of the neck among the cavernous lymphangiomata. They consist of connective-tissue trabeculæ, within whose branched and intercommunicating caverns a serous fluid is contained. This form of congenital cavernous formations occurs most frequently among females, has been usually observed in immature children, and is generally complicated with other malformations. The tumor always (Steinwirker) has its principal seat at the lower portion of the occiput and upper part of the neck, is spheroidal, with a smooth surface, and

divided in the median line of the body by a furrow into symmetrical halves. In some cases the tumor extended from the ridge of the occipital bone to the middle of the scapulæ, and anteriorly to the ears. In one case it extended forwards on both sides until its halves nearly touched in front. In all cervical hygromata (Steinwirker) the integument of the body was infiltrated with serum, and in one case the œdematous skin was formed into folds, beneath which were many cysts filled with a clear fluid. They are usually composed of two symmetrical cysts, divided into smaller compartments. The walls of the cysts are in most cases very delicate and transparent, but sometimes more firm and fibrous, resembling the pericardium. In cystic hygromata the cavities present either simple cystic conglomerations, or the cysts communicate with one another. Köster demonstrated in a case the general communication of the closely crowded caverns. He also proved the direct transition of the cysts into ampullary canals and spaces, and recognized the connection of the latter with the sinuses of lymph glands.

A common form of acquired lymphangioma may be illustrated by the following case reported by Hecker.

"A female, aged 32. Upon the skin in many places were sixty smaller and larger tumors, many about the size of a cherry, comparable to lipoma angiectodes; others compact, like fat tumors, others soft, fluctuating, and containing a serous fluid. The integument of the ovoid tumors was thickened, but of normal color, that of others was thinner, of a bluish color. A large, movable, soft tumor was located upon the neck, another of apple size upon the buttocks. The largest one commenced at the seventh cervical vertebra, and from both scapulæ, with a pedicle sixteen inches in diameter, which extended down to the first lumbar vertebra, occupying the entire back. The greater part of the tumor felt like a lipoma, but in a few places it was soft and fluctuating. The integument was traversed by few vessels, but strongly pigmented, somewhat reddened during fever, and upon its surface were cysts of pea-size and soft tumors filled with serum. After amputation it weighed thirty-one pounds, and lost by drainage several pounds of a serous, albuminous fluid. The microscope showed it to consist of hypertrophied connective tissue, the interstices of which were filled with serum and a white, firm, lardaceous mass. The skin was in some places an inch thick, and was traversed by dilated and tortuous veins, which did not collapse. The arteries were dilated, elongated, and tortuous, but their coats did not exhibit any change."

The presence of the numerous caverns formed by the greatly expanded connective-tissue interstices, filled with a fluid rich in albumen and salts, and the fat-masses, established the nature of the tumor. Analogous conditions have been observed in a number of cases. In Lücke's case the tumor in its interior organization presented a cavernous trabecular tissue, with meshes filled partly with a coagulum and partly with a serous fluid containing small cells, like lymph corpuscles; in Reichel's case of lymphangioma cavernosum cysticum, the hard perineal tumor which felt like a lipoma, proved on examination to be a conglomeration of larger and smaller cavities, with interposed fat and connective tissue. Prof. Waldeyer found in the meshes of the connective tissue transparent cysts, communicating one with another, and with the lymphatic lacunæ of the connective tissue. The fluid found in the cysts was weakly alkaline, perfectly clear, slightly adhesive, coagulated upon exposure, and contained isolated red blood-discs, and a few amœboid corpuscles resembling lymph-corpuscles. Upon the interior surface of the cysts lymphatic endothelium appeared in perfect outline; in Hofmokl's case of lymphangioma cavernosum, the tumor, which occupied the entire right half of the thorax and lumbar region, consisted of caverns communicating with one another by canals. The case of Hecker exhibits other interesting phenomena: an enormously thickened skin due to hypertrophied connective tissue, coexisted with a very remarkable and abundant supply of veins, which were greatly dilated, elongated and tortuous. This extraordinary development of the veins necessarily led to stasis of venous blood, and the fluid which filled to repletion the lymph spaces was transuded blood-serum. The cysts of pea-size, and soft tumors filled with serum, which studded the surface of the large tumor, were manifestly ampullar formations in open continuity with widely dilated lymph-spaces. The gelatinous coagulum which formed characterized the exudation as an impoverished lymphous fluid.

Diagnosis.—The diagnosis may be readily determined by the nature of the fluid emitted, or withdrawn by puncture. But in cases unaccompanied with any discharge, and without the assistance afforded by the examination of the contents, the diagnosis is at best uncertain. Most frequently lymphangiomata have been mistaken for lipomata, and occasionally, when there was no doubt of the presence of a fluid, for cold abscesses. The covering integument is sometimes thin and glossy, sometimes pigmented, bluish; at other times thickened and rugose. Usually the tumors are soft, elastic, resilient, but non-fluctuating. When the cavities are large, as is usually found in cystic hy-

groma, fluctuation is present. Sometimes the sensation is that of a congeries of cords which roll under the examining fingers. In some cases the tumor can be diminished by pressure, but refills immediately upon withdrawal of the pressure.

Treatment.—The methods of treatment which have yielded the most favorable results, have been puncture, injection, excision, amputation, and ligation of arteries. Puncture has been resorted to occasionally as a temporary expedient. In several instances the evacuation of the fluid has been followed by collapse and obliteration.

In the case of Hofmokl, the tumor collapsed after an exploratory puncture and the evacuation of the contents. It had, however, completely refilled in six days. It was again punctured, and soon afterwards erysipelas attacked the entire integument covering it. This subsided in a week, leaving the tumor much smaller and presenting in places distinct hardness. Twenty-six days afterwards the tumor had diminished by two-thirds of its original size, and was solid.—In a somewhat similar case, reported by Gjorgiewic, incision of the tumor was followed by the establishment of a lymph-fistula, which proved intractable. The tumor was located upon the inner side of the right thigh, below Poupart's ligament. Prof. Billroth, supposing it was a cold abscess, incised it, and was forced to the diagnosis of a cavernous lymph-tumor. The lymphorrhagia continued uninterruptedly for a week, and then suddenly ceased. The tumor immediately became tense, the inguinal region reddened, became hard and painful, headache and vomiting occurred; upon the subsidence of this condition the discharge reappeared. Similar attacks recurred at short intervals, and always disappeared upon the reëstablishment of the lymphorrhagia. Finally, a white deposit appeared about the wound, which was scraped off and the entire wound cauterized with fuming nitric acid. Failing with the nitric acid, ineffectual efforts were made with carbolic acid, compression, piercing with the galvano-cautery, and repeated applications of creasote. Finally the entire tumor was extirpated.—In the case of Broca, the tumor was punctured, but two days afterwards it was reproduced to the same size as before the evacuation of the fluid; subsequently Broca emptied the tumor by puncture, and then injected perchloride of iron to set up adhesive inflammation. These means, combined with continuous pressure, seemed to prove quite successful, for the tumor was not reproduced to the same extent, and remained stationary.—In a case recently reported by Dr. Green, a large fluctuating cyst, situated upon the posterior part of the pelvis, was treated successfully by the withdrawal of a small quantity of the fluid, and the injection of a like amount of the tincture of iodine into the sac.—Reichel punctured the tumor in the case of A. W., but only a few drops of serous fluid escaped. Subsequently, nearly every day for a month, he injected it either with dilute or pure tincture of iodine, and, finally, with chloroform, without success. No inflammation followed. He then introduced threads, silk as well as cotton, which only excited a limited inflammation and suppuration. Finally, the tumor was removed by the galvano-cautery noose. The child died with symptoms of hydræmia and acute œdema pulmonum.—Amputation has been more frequently resorted to than any other surgical procedure. Hecker failed in the case of Rosina Geng, but subsequently succeeded in the partial removal of a tumor weighing thirty-two pounds from the buttock of Therèse, the bastard daughter of Rosina. Czerny completed the removal by a second operation. The large tumors are generally very vascular, and great danger is to be apprehended, because of the abundant supply of large, tortuous veins, with thickened coats, which do not collapse after division, and have to be ligated. Hecker encountered only two arteries, but had to ligate twenty veins. Better success has been obtained by amputation with the galvano-cautery. Bryk has employed this method with remarkable success.

Chadwick removed a lymphangioma fibrosum by incising the vaginal wall and capsule, and then, with the handle of the scalpel, enucleating the tumor, nearly as large as a hen's egg. A second tumor was removed in a similar manner. A few ligatures were necessary. The lateral edges of the incision were brought together with silk sutures.

Excision has usually been practised in cases of congenital macroglossia and macrochilia. These operations have not usually been accompanied with excessive hemorrhage, but in exceptional instances the loss of blood has been very great, in consequence of dilatation of the veins. In such cases compression and sutures have been resorted to to control the bleeding veins.

The ligation of large arteries has been occasionally resorted to. Bryk has performed the operation several times with varying success. It is only practicable in a few cases.

Lymphatic Œdema.

Lymphatic œdema is a symptom of different pathological conditions, but is always, directly or indirectly, the result of interruption to the lymph stream.

The current of the lymph is in a reverse direction to that of the blood-supply. The lymphatic system receives, through its rootlets, which are distributed through the tissues, the fluid transuded from the arterial capillaries, and empties it into the venous trunks near their termini. Recklinghausen estimates the force concerned in the locomotion of the lymph to be equal to the difference in the arterial and

venous blood pressure, the venous being always the minimum. To this must be added the factors derived from the contraction of the walls of the lymphatic vessels; from compression of surrounding and contiguous parts; from the movements of respiration, and from the absorption of the chyle. The movement of the lymph is very much slower than that of either the arterial or venous blood-currents. The pressure in the lymph-vascular system is very variable; in a normal condition the vessels are never distended.

Wagner defines dropsy to be "the morbid accumulation of a fluid, more or less like blood-serum or lymph, in the parenchyma of the tissues, or in closed serous cavities." "Œdema," he says, "consists in a pathological accumulation of quantitatively and qualitatively changed lymph in the lymphatic radicles, also in other spaces in the tissues."

Mr. Hutchinson believes that the lymphatic system takes a large and chief share in the production of œdema. The direct communication of the lymph-vessels with the areolar interspaces affords ample facility for œdematous accumulations. In fact all œdemas caused by erysipelatous and elephantoid inflammations, and by thrombosis of venous capillaries are lymphatic, and it may be conceded that all persistent local œdemas, not due to interruption of the current in the principal vein, or of visceral origin, are lymphatic.

Causes.—The causes may be summarized under four different forms of obstruction—interruption to the venous current in or near the heart, narrowing or occlusion of the thoracic duct, lymphatic trunks, or capillary vessels. The effect of obstruction at the cardiac orifices and of the thoracic duct have been sufficiently described in the section on effusion of chyle and lymph into the peritoneal and pleural cavities. Inflammation is the most frequent cause of obstruction in the lymphatic trunks and capillaries. Recurrent attacks of erysipelas are constantly associated with œdema. It occurs most frequently in moist and hot climates, and has been observed most often in males. In tropical climates it is believed to be caused by the *filaria sanguinis hominis*.

Symptoms and Diagnosis.—Persistency is one of the most marked characteristics of lymphatic œdema. When due to central obstruction it is usually symmetrical. When to obstruction or obliteration of a lymphatic trunk or of capillary vessels it is asymmetrical and confined to a limb. When this obstruction has been caused by lymphangitis there will be a history of recurring attacks of erysipelas or erythema, attended with pain, fever, great thirst, vomiting, and rigors. These attacks of inflammation, and stasis of lymph, produce hypertrophy, which may be confined to the epidermis, or may extend to the cutis and cellular and adipose tissues. The cellular tissue will be more or less filled with fluid. The lymphatic vessels and radicles may be dilated, and vesicles may be formed on the surface which, when ruptured or punctured, will discharge, in varying quantity, a serous or milk-like fluid. Sometimes the superficial veins are very much enlarged. It may be distinguished from venous œdema by its persistency, by the absence of phlebitis, by its greater firmness, greater hypertrophy and brawnyness of the skin, and by the greater development of the *panniculus adiposus*. The firmness is not hard as in scleroderma. In the latter condition there is no œdema and no pitting.

Treatment.—For those cases dependent upon obstruction in the venous orifices or the thoracic duct, but little can be done. When the œdema is due to inflammatory action it is more amenable to treatment. Rest, with elevation of the part, inunction with mercurial ointment, pressure by the application of elastic bandages, and the iodide of potassium internally, may effect a cure, or at least arrest the progress of the disease. Continuous pressure and ligation of the main artery supplying the affected limb have yielded the best results.

Lymphangitis.

Lymphangitis may be either simple or septic. Simple lymphangitis may be confined to the lymphatic network, or to the larger vessels. Curnow denominates the former reticular, and the latter tubular lymphangitis. In either form the inflammation may be limited to the lymph apparatus, or be diffused, involving the contiguous skin and cellular tissue. Simple lymphangitis may be either traumatic or idiopathic.

Reticular lymphangitis may attack any part of the lymphatic network, and is usually the result of an injury, a prick, scratch, or abrasion. The part becomes red, very painful, soon followed by resolution or suppuration.

Tubular lymphangitis is confined to the larger vessels, and is exhibited in straight or wavy lines, following the course of the vessels, or in hard, knotted, cords extending to, and not infrequently involving the glands, which become tender and swollen. The coats of the vessels are thickened, their calibres dilated. Sometimes they are blocked up with thrombi. The lymph-stream may be interrupted, and the affected tissues may become œdematous, followed by sclerosis and hypertro-

phy, which may be diffused or nodular. Cellulitis is a constant complication of tubular lymphangitis, which very often terminates in suppuration.

Diagnosis.—The diagnosis is not difficult. It is distinguished from erysipelas by the presence of red lines, starting from a wound and following the course of the lymphatic vessels; and in the tubular form by their hard, knotted feel. Fever is always present, sometimes intense, and usually begins with a rigor.

Treatment.—When caused by a wound the treatment should be directed to the proper management of the wound, which should be cleansed, disinfected, and otherwise treated according to the principles of surgery. Hot fomentations are advisable in the stage of acute inflammation. When this has subsided, application may be made of a solution of nitrate of silver, collodion, or cotton-wool. In the later stage of induration and hypertrophy, inunction with mercurial ointment, kneading, massage, and pressure by systematic bandaging, either with flannel or elastic bandages. Internally the salines, vegetable acids, and quinine during the fever, and, subsequently, tonics, iron, and quinine.

Septic Lymphangitis.

Septic lymphangitis is that form of inflammation of the lymphatics produced by the absorption of putrescent material and animal poisons. It may supervene during the course of diphtheria, typhus and typhoid fever, and erysipelas. It is that form of lymphangitis produced by snake bites, and dissection wounds, and which is so frequently associated with puerperal inflammations.

Treatment.—This form of disease is far more dangerous than simple lymphangitis, and demands prompt and energetic treatment. Fresh air, quinine, opium, a nutritious and easily digested diet, and stimulants, are the most valuable remedies. Abscesses must be freely opened and disinfected. The strength of the patient must be supported. Iron is sometimes of great service. Injections of carbolic acid are recommended, especially in those cases associated with erysipelas.]

PART III.

DISEASES OF THE DIGESTIVE TRACT.

DISEASES OF THE MOUTH.
DISEASES OF THE TEETH.
DISEASES OF THE INTESTINES.
DISEASES OF THE RECTUM.
HERNIA.

PART III.

DISEASES OF THE MOUTH, PHARYNX, AND ŒSOPHAGUS.

DISEASES OF THE MOUTH.

By George Pollock, Esq.

Revised by J. William White, M.D.

Tonsillitis. Quinsy. Cynanche tonsillaris.—The most common morbid affections of the tonsils may be thus classed:

1st. Acute inflammation and abscess.

2d. Chronic inflammation and enlargement.

3d. Ulceration and sloughing.

1. [There is a simpler variety of acute tonsillitis than that here described, in which the inflammation does not penetrate beyond the sebaceous crypts of the glands. The hoarseness, tenderness, and dysphagia are very slight, and there is no tendency to suppuration. In this mild, or follicular form of the disease, an astringent gargle, a gentle purge, a warm foot bath, and restricted diet, will usually induce resolution in from two to five days.]

Acute inflammation of the tonsils is generally preceded or attended by a distinct rigor or chilliness, and general feverish disturbance. Accompanying or following such constitutional irritation, will be found pain in the fauces, and tenderness of the upper part of the throat, in every effort at deglutition. The pain at first is not acute, but rather as if the parts had been bruised, and is diffused over the back part of the mouth and the pharynx. As the case progresses, the local mischief becomes more evident. At first a mere blush, the redness of the part becomes more marked. With the altered color of the mucous membrane, tumidity of the tonsil will be observed, and before long œdema of the surrounding soft structures. With the increase in the severity of these local changes, it usually becomes evident that the mischief is confined to one side. But the evils of tonsillitis are not restricted to these symptoms alone, nor do the sufferings usually stop short here. Pains in the jaws, and headache; fever, and loss of appetite; often severe suffering in the part affected; a loaded, creamy, and swollen tongue, with very foul breath; muffled articulation; great difficulty in swallowing, and fluids attempted to be swallowed escaping through the nostrils; great fear of strangulation; the patient frequently obliged to sit forward, or lie on one side, to allow the abundant saliva to drip into a basin, or drain away on a sponge:—these are the symptoms which mark the progress of the complaint, and comprise the chief characteristics of the attack. As the attack advances, the local examination of the mouth detects an increase of swelling, which usually runs forward in the substance of the soft palate, and on the side affected; in aggravated cases even implicating the tissues which cover the hard palate as far forwards as the incisor teeth. With the increase of swelling, a central softening spot will sooner or later be detected, either with the eye, or more frequently at a comparatively earlier period, by an examination with the finger.

Much difference will be found, in different cases, as to the period at which pus is formed in an attack of acute inflammation of the tonsils, *i. e.*, as to the period when the abscess may be relieved by incision. In some instances from forty-eight to sixty hours will suffice to ensure such a desirable condition. In other cases, many days will elapse before matter can be detected by the point of the finger, or upon the thrust of a scalpel. During all this time the patient passes his days and nights in misery; is not able to take any solid food, and but little fluid nourishment; obtains very little sleep, and that little of a disturbed character; has difficulty in respiration, caused by some œdema of the glosso-epiglottidean and aryteno-epiglottidean folds, and often

greatly aggravated by fear, and a nervous horror of approaching suffocation. [If this symptom exists it is indicative of imminent danger from suffocation, as the œdema glottidis may at any time produce complete closure of the larynx. It is, however, much less common than the aphonia, dysphagia, and difficulty in opening the mouth.] Inflammation in the acute form attacking the tonsil seldom terminates in resolution; as a general rule, it runs into abscess. [This is true only of the parenchymatous variety of the disease, in which the entire gland, including the inter-follicular connective tissue, is involved in the inflammation.] This abscess will burst sooner or later if left to itself; and when burst, the urgency of the symptoms will at once commence to subside. But if the abscess can be opened by the surgeon a day or two previous to what would otherwise be the spontaneous period of perforation, by so much will the patient's suffering be alleviated.

The causes of this form of inflammation appear to be more or less associated with some disordered state of health, which renders the tonsils and throat especially susceptible to the influence of cold; for to direct exposure to cold may usually be attributed the immediate cause of an attack. But the patient will generally be found to have suffered from some constitutional disturbance, previous to the commencement of the sore-throat. Often he is of a gouty habit. Rigors and flushes commonly herald the attack, before the gland itself becomes the seat of inflammation. Abscess, the result of simple inflammation of the tonsil, irrespective of those cases which are complicated with scarlet fever, is a rare affection in childhood. It is seldom met with before puberty. It is not a frequent attendant on old age. It appears to be a disorder of youth and middle life. [It is most frequent here between the ages of twenty and thirty.]

It rarely occurs that both tonsils are simultaneously affected. But it does sometimes happen that after one tonsil has been the seat of suppuration, the opposite one becomes inflamed and runs into abscess. This, however, is infrequent. We occasionally meet with individuals who are subject to recurring attacks of inflammation of the tonsils, and quinsy. These attacks occur every one or two years for some time, often at shorter intervals.

Such conditions indicate especially, and prominently urge, the importance of constitutional treatment rather than simple attention to the local evil. It has constantly been found most serviceable, directly a patient has anticipated the recurrence of such an attack, to administer a stimulating emetic. The action of vomiting not only relieves, by emptying the stomach, but appears also to have some beneficial action locally. In fact, individuals subject to such attacks, and who have adopted such a course of treatment, have expressed themselves satisfied, that suppurative mischief has been warded off by recourse to an emetic in the very earliest stage of a sore throat.

[In this stage Velpeau recommended insufflations of powdered alum; Niemeyer the energetic use of cold; Trousseau an expectant plan of treatment; guaiac, tincture of capsicum, sumach, the external use of turpentine, and the submucous injection of morphia have all been more or less highly extolled as specifics, but the evidence in their favor is inconclusive.]

As the attack is usually of a very debilitating character, an emetic of mustard is preferable, on every account, to one of antimony or ipecacuanha. Fomentations to the throat externally, inhalations of the steam of hot water pretty constantly, and a free purgation after the action of the emetic, should be the chief points of treatment. We strongly condemn *as dangerous*, in every sense of the word, the abstraction of blood, either locally or generally, either by leeches or by any other means. Life may be sacrificed by recourse to such treatment.

[If the patient be strong or plethoric, leeches behind the angles of the jaws and scarification of the surfaces of the tonsils often give immediate and sometimes permanent relief. They should be followed by the use of guaiacum in lozenges, or as a gargle in the form of the ammoniated tincture. When it is apparent that suppuration is inevitable, poultices to the throat and hot inhalations are indicated.]

Blisters appear equally unnecessary, though perhaps not equally prejudicial in their consequences. Mustard poultices appear to afford much relief in many cases; their application is often grateful to the patient's feelings; and by repeated application they can be made to keep up sufficient counter-irritation, without the inconvenience of producing a sore place; whereas a blister is a worrying annoyance to one who has already very great discomforts to put up with; and the subsequent discharge is a considerable nuisance, as it runs down and soils the linen, and stiffens the bed-clothes into which it soaks. Moreover, a blister often abstracts a large quantity of serum, and occasionally leaves a very red, irritable, and painful sore on the neck, which, added to the exhaustion following an attack of quinsy, is by no means advantageous.

This disorder is one that calls much upon the strength and vital powers of the

patient. During the greater part of the attack food is taken but sparingly, and that in a fluid form. It therefore behooves us to husband the forces rather than diminish them by heroic treatment. As there is much difficulty in swallowing, the less a patient is pestered with physic the less uncomfortable will be his day. At night it may be desirable to procure sleep, if he be restless; and for such a purpose a few drops of morphia will in all probability suffice.

So much is the patient reduced by such an attack, that when the pus is evacuated by puncture, or escapes by an ulcerated opening, it will generally be found that some days of nutritious feeding are requisite before he regains the strength he possessed and the substance he carried previous to his illness.

Internal local treatment is more open to discussion. Some writers advocate the free application of the solid nitrate of silver to the surface of the inflamed membrane; but it is somewhat doubtful what amount of benefit is secured by this method of treatment. It is certainly attended by one disadvantage; it produces a good deal of local discomfort, leaves a most nauseous taste for some time in the mouth, and gives rise to constant hawking and spitting, until the superficial epithelial sloughs, occasioned by its application, are released or removed from the inflamed membrane. We are not aware that the application, under the acute conditions we have described, is followed by any satisfactory or beneficial results.

If the swelling of the tonsil be considerable, the surface very red, and the part very tender, and yet no very distinct indication of pus be present, it may appear sometimes advisable to make a deep puncture into the part to relieve congestion; or one or two incisions less deep. But as a rule, if the urgency of the symptoms be not great, it is far better to wait the formation of matter, rather than experimentally adopt an exploratory use of the scalpel. Every sensible practitioner studies the feelings of his patient; every good surgeon avoids the uncertain or unnecessary use of the knife. Incisions, if made, often occasion much suffering—are especially dreaded by some who have previously submitted to such treatment—and seldom appear to hasten the escape of matter. When, however, pus is detected or suspected, the part should without loss of time be punctured with a knife.

There are some few precautions requisite when any pointed or cutting instrument is used to open an abscess at the back or side of the mouth. The knife itself need only have, from its extremity, a cutting surface of about half an inch. Whatever knife be employed, it is best to protect the blade so as to cover its cutting edge up to this extent, by wrapping round it, from the handle towards the point, a piece of rag or plaster. A sharp-pointed straight bistoury is of all knives the most convenient for the surgeon's purpose.

In passing the instrument, when protected as described, into, or on withdrawing it from the mouth, the risk of wounding the lips or tongue is necessarily lessened—we may say is avoided; for no such accident should occur in proper hands. On puncturing the tonsil or abscess, an important precaution must be observed. The point of the knife must be kept turned towards the median line, especially after its point is buried in the soft tissues, and out of sight; on no account is the direction of the wound or thrust of the knife to be outwards. By due attention to this simple caution, all risk of wounding the larger vessels, lying on the outer side of the neck, is certainly avoided.

[On the outer side of the tonsil nothing intervenes between the gland and the internal carotid artery but the pharyngeal aponeurosis and the superior constrictor. The close proximity of the gland to this vessel has in four instances, reported by Grisolle, Caytan, Müller, and Norton, given rise to ulceration of the artery, with serious hemorrhage in one case, and immediate death in the others.]

The patient's head should be fixed, either against the back of a chair, or by the hands of a third person. A sudden movement while the knife is passing into the tonsil might lead to grave mischief, as the instrument might accidentally and unavoidably be thrust in the wrong direction.

The mouth is occasionally opened with some difficulty. [Frequently the patient can barely separate the teeth, the difficulty being due to the great tension of the bucco-pharyngeal fascia, which is increased when the jaws are opened.] And the tongue may be so much implicated in the inflammation that the patient cannot, by his own efforts, sufficiently aid the surgeon to obtain a good view of the swollen tonsil. Under such circumstances, a broad spatula, gently applied to the surface of the tongue, will expose the part sufficiently to permit the abscess to be punctured in a satisfactory manner.[1]

[1] A practical hint in passing may here be thrown out, on the best method of examining the throat generally. With many patients it is often a matter of some difficulty to gain a sight of the fauces. The tongue is pushed upwards directly the mouth is opened, and when the spatula is applied with the intention of pushing down the tongue, the patient immediately appears to resist its application with a steady and firm effort. *If, however, the*

As soon as the abscess has been punctured, the pus generally flows freely on the withdrawal of the knife; sometimes so abundantly and so suddenly that it runs into the gullet; and from this circumstance, or from the fact that it is often very fetid, it greatly nauseates the patient, sometimes to vomiting. Shortly after the escape of the pus, the patient usually becomes comfortable, expresses himself wonderfully relieved, and soon desires to partake of food. Convalescence is usually rapid and satisfactory.

As we have already said, occasionally, but rarely, the opposite tonsil becomes inflamed and suppurates. Under such circumstances an early tonic and stimulating course of treatment may be requisite; and the medical attendant must look, for his guide, to those symptoms which would indicate constitutional deterioration and physical exhaustion, to be met by generous diet and wine, or other stimulants.

In the treatment of all cases of cynanche tonsillaris, there must be a certain amount of anxiety; but the anxiety as to the symptoms which precede the formation of the abscess, is as nothing compared to the anxiety we may have to encounter when unfavorable symptoms are set up *after* the evacuation of the pus. [Cases are recorded in which the sudden bursting of a tonsillar abscess caused death by suffocation; others in which the pus passed along the course of the great vessels of the neck and penetrated the chest, or, as in a case mentioned by Velpeau, burrowed through the cellular tissue of the neck and appeared above the clavicle.] In an unhealthy constitution ulceration may supervene upon the incision, and be followed by sloughing sore-throat; or œdema of the surrounding soft tissues may arise, and traveling downwards around the larynx, pharynx, and œsophagus, terminate the patient's life in a few days. But fortunately these are the rarer evils following upon the evacuation of pus, the result of simple acute inflammation of a tonsil, or true quinsy; the usual history of which complaint is, that directly the abscess has burst or is opened, convalescence is perfect and speedy.

The sore-throat of childhood is rarely acute, inflammation of the tonsil ending in abscess. It is usually the symptom or accompaniment of scarlet fever, or partakes of that more frightful and fatal character known as "putrid" or "sloughing sore-throat," of which we shall hereafter speak. The latter is usually accompanied by enlargement of some of the glands of the throat or parotid. In quinsy the throat-glands are seldom affected, and if affected, not to any extent.

Several of the symptoms referred to above, as indicative of the formation of pus in an inflamed tonsil, are present, to some extent, under conditions which are apt to be mistaken for quinsy.

A decayed tooth, or a broken stump, will often set up a considerable degree of alveolar inflammation, and be followed by an abscess of the gum or corresponding maxillary region. This condition occasions much difficulty in opening the mouth; the breath is fetid; the tongue becomes very foul and loaded; there is great difficulty in deglutition, and pain of face on the side affected. But generally one marked difference exists between the symptoms of quinsy, and an abscess originating in alveolar inflammation; when a tooth or a stump is the cause of the mischief, there is always more or less swelling of the *face*, and tenderness and swelling, especially over the *maxilla* affected. In quinsy, if there be external swelling present, it is not over the face or cheek; it is confined to the submaxillary region, and the neighborhood of the parotid.

In all cases of inflammation, either within or external to the mouth or throat, the medical attendant should look with suspicious care to the condition of the mouth. There are few circumstances in practice more apt to be overlooked, than evils which arise from the irritation of decayed teeth.

2. *Chronic inflammation*, terminating in enlargement of the tonsil and thickening of its mucous surface, is a very common condition; more especially to be observed in children, and in young persons of both sexes under the ages of from twenty to thirty. The tendency to this form of diseased action and enlargement, is mostly observed in individuals of a strumous or lymphatic habit. The enlargement frequently commences as early as the second year of life, and has been observed to occur more especially in children who have been weaned when very young, or brought up by hand-feeding. Less frequently, it does not show itself until towards the period of approaching puberty. It has a tendency to affect females in a greater proportion than males, though it is by no means an infrequent complaint in the latter sex.

The commencement of chronic enlarge-

spatula is, without the slightest weight, laid on the tongue, it gradually appears to contract and is drawn backwards, and the fauces are exposed to full view. No force or pressure is requisite on the part of the surgeon to effect this; the weight alone of the spatula appears sufficient to ensure the object desired. This experiment has been constantly illustrated, on patients suffering from throat-affections, to our pupils.

ment of the tonsils appears to be unattended by any marked symptoms, local or general. Rarely is attention drawn to the condition of the part until either the thickness of the articulation, or loud snoring in sleep, excites the mother's curiosity, or gives rise to anxiety, when an examination of the throat is instituted. Pain is never a symptom attendant on these swellings. The only local symptoms are those which necessarily arise from the mechanical encroachment of the tonsils, in the median line betwixt the external oral and nasal apertures, and the internal apertures of the breath and food-passages. The intensity of these symptoms will depend on the size of the masses on either side of the fauces.

The causes which produce this chronic enlargement of the tonsils are not satisfactorily established. A careful inquiry into the history of a large number of cases has failed to detect any one specific reason to account for this diseased action. It does not appear to depend on cold, or insufficient nourishment, nor on want of cleanliness; for it will be met with in the children of the upper, as often as in those of the lower classes, and as often in those who are well provided and tenderly cared for, as in those who are the children "of sorrow and acquainted with grief."

This diseased action does, however, appear to affect in a larger proportion those children who have been brought up by hand or early weaned, than those who have been supplied for a sufficient time with the mother's breast-milk. The enlargement of the tonsils will also frequently commence, on the convalescence from severe attacks of the various eruptive or other forms of fever. Most frequently, however, their growth is grafted on a strumous diathesis.

The forms under which enlarged tonsils occur deserve some attention. One of the most frequent appears to be a uniform globular projection on either side, to a greater or less extent. In this condition the swelling may cease to grow, and remain stationary for years, without inconvenience or injurious consequences. Or the glands may slowly and steadily increase in size, until their surfaces touch below in the median space and above either side of the uvula. [In a healthy condition the glands should not project beyond the level of the anterior and posterior half-arches between which they lie.] In other instances, the tonsils appear to enlarge towards the soft palate, and often upwards past its free border, as well as downwards so low that the lower end is hidden from view by the base of the tongue, and is only with care detected when the latter is well depressed; or the tonsil on one side only may be seen to project, a perfectly round mass, which is attached to the fauces by a thin pedicle of mucous membrane: occasionally an outgrowth has been seen, a pendulous tumor hanging from the natural position of the tonsil.

The surface of an enlarged tonsil is generally somewhat uneven, often very much pitted; the mucous membrane thick and velvety, and seldom without an increased vascularity. In many instances all these conditions may be observed in an aggravated degree. Often, superficially ulcerated spots are seen dotting the surface of the swelling; or, what is more common, small points of thick sticky sebaceous secretion will be observed, marking the orifices of some of the ducts which lead into the substance of the gland-tissue.

The fauces, especially when the enlargement of the tonsils is considerable, may often be seen covered with a viscid yellowish semi-purulent secretion; this clings to the posterior surface of the glands, or lines the walls of the upper portion of the pharynx.

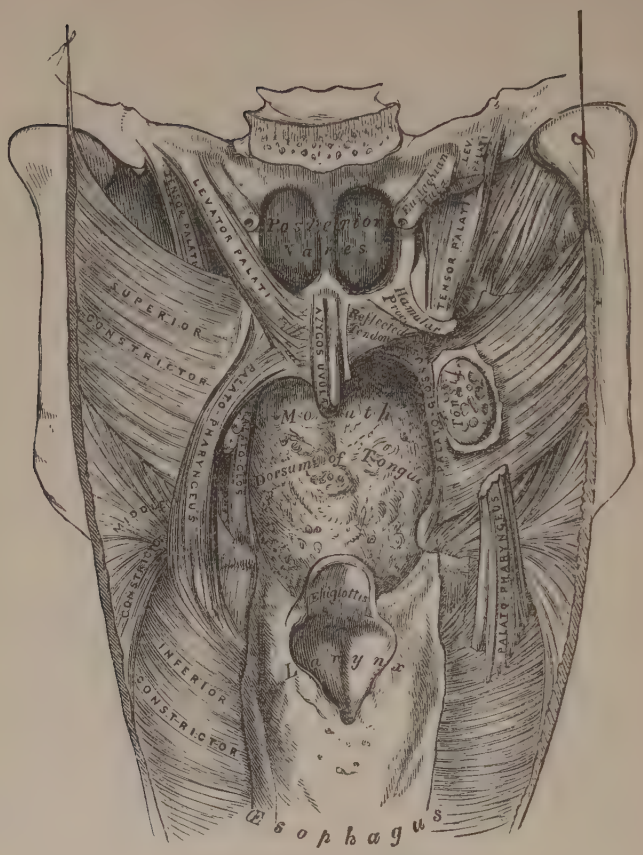
When the enlarged gland projects to any extent above the soft palate, some degree of deafness is occasionally complained of. This concomitant symptom appears to depend rather upon the thickened condition of the mucous membrane, which, extending from the tonsils, runs up to, and may line, the Eustachian tube, than upon any actual encroachment of the gland on the orifice of the tube.

[The accompanying cut from Gray (p. 496), representing the pharynx laid open from behind, may serve to render the pathological conditions resulting from hypertrophied tonsil more comprehensible.]

Enlarged tonsils appear to be the result, not the cause, of constitutional derangement, provided they do not become large, or encroach much on the isthmus of the fauces. But if they increase in size, and much lessen the passage from the mouth to the pharynx, many unpleasant effects may be detected. The voice is generally somewhat unnatural and muffly, and the pronunciation thick. So that enlarged tonsils appear to be a perfect impediment to the production of fine sweet notes in song, or clear sonorous tones in speech. The breath is often offensive; partly rendered so by the decomposing sebaceous secretion sticking in the orifices of the glands, partly by the thick semi-purulent mucus which clings to the fauces.

The enlarged glands are constantly liable to attacks of ulceration, and sometimes to acute inflammation attended by fever. If large in children, they produce more general effects on the system than in adults. They now interfere with perfect

[Fig. 348.



Posterior view of fauces (Gray).]

and free respiration. At night the child snores loudly; often awakes in his sleep, and as often in a state of alarm. In some instances the natural and requisite amount of rest is so interfered with that the child's health suffers. There is also frequently some little inconvenience in swallowing, and care is observed to be taken by the child that only small quantities of food be swallowed at a time.

[The interference of the enlarged glands with respiration is by far the most serious of their evil results. The occlusion of the nasal channel posteriorly obliges the patient to keep the mouth almost constantly open, and renders him exceptionally liable to the external influences which produce inflammation of the respiratory tract, while the persistent obstruction to respiration leads to serious changes in the walls of the thorax. According to Lambron the characteristic deformity met with in cases of enlarged tonsils is a circular depression of the walls of the chest at about the junction of the lower and middle thirds, corresponding with the attachment of the diaphragm internally, and evidently due to the constant energetic contractions of that muscle to overcome the obstacle to free respiration. (Mackenzie).]

If a section of a portion of an enlarged tonsil be examined carefully, it will be found, to the touch, firm in consistence, and somewhat elastic when pressed. The face of the cut surface will present several small uneven and irregular depressions, from which may be picked, every here and there, or squeezed out, small collections of sebaceous matter. The structure of the enlarged mass consists of condensed areolar tissue, which often runs like bands between and around the depressions above alluded to. The naturally soft structure of the gland is so condensed and firm, that it assumes the character of fibrous tissue intersecting the substance of the growth in every direction.

The accumulation of epithelial secretion within the ducts of the glands, occasioned by the obstruction of their orifices, is the explanation of the formation of the cavi-

ties seen on a section of the gland; for as the secretion increases, and cannot escape through the obstructed orifices of the ducts, it collects in the latter, dilates them, and sets up chronic inflammation of the structure of the gland itself, which terminates in its permanent enlargement.[1] This secretion will frequently be observed to escape from the surface of the enlarged tonsil when it is firmly pressed between the blades of the vulsellum prior to removal.

The treatment of enlarged tonsils may be summed up in a few lines. Unless the voice be affected to such an extent that it becomes desirable to lessen or remove them; unless the disturbance to the sleep of the child be manifestly interfering with health; unless the breath be rendered fetid or offensive by the secretion from the ducts; or unless some other cogent reason render it desirable to interfere with the mass—it is better to leave the tonsil in its slightly enlarged condition, without the application of any local or constitutional measures. If a child so affected be delicate, and the tonsils appear increasing, we prefer constitutional to all local treatment short of that of removal. In the early stages of enlarging tonsils, if detected, it would be best to administer tonics as a rule, as they certainly act beneficially as regards the health; and by so doing, as far as experience allows us to hazard an opinion, arrest the progress of the growth. At any rate, under a tonic treatment such enlargements frequently remain stationary. Steel-wine, muriated tincture of iron, citrate of iron, syrup of iodide of iron, and cod-liver oil, each according to the constitutional peculiarity, may be prescribed with safety, and taken with evident benefit for many weeks or months. We need hardly caution the reader on the importance of attention to diet; and with very weakly children, sea-bathing is of the utmost advantage.

Local applications are frequently recommended, and too constantly adopted. Nitrate of silver rubbed over the surface, or points of nitrate of silver run into the substance of the gland, sometimes nitric acid carefully applied to portions of it; stimulating gargles; and a variety of troublesome and useless applications, have had their advocates for the arrest or removal of these masses. But an examination of a portion of a gland removed by excision will show such structural changes, such a fibrous thickening of the finer areolar tissue, that it appears to the author a useless waste of time and material to attempt to procure absorption of such dense tissues. Nothing short of an actual slough can do good, if caustic be used; no stimulating application can offer much hope of action on such a structure; it is therefore best not to waste time or inflict pain by having recourse to such useless local measures. If constitutional treatment does not arrest, and local treatment be requisite, removal by the knife of a portion of the gland is the speediest, and, in our opinion, the only efficient remedy. The surgeon with a knife can remove all that is necessary in a few seconds; and the patient will be entirely rid of the consequences within a week after.

When the glands are so large that some portion must be removed, to relieve the symptoms of discomfort or distress from which the patient suffers, the operation is simple enough in adults; but may be somewhat troublesome when necessary in a young child.

It will be found advantageous to place the child sufficiently under the influence of chloroform [or ether], so as to allow of the mouth being easily kept open. The tongue being then depressed, a portion of the gland may be seized with the vulsellum, and rapidly cut off with a blunt-pointed straight bistoury, the cutting-edge of which should only be exposed, near the point, to the extent of an inch. If there be any difficulty in keeping the mouth sufficiently open to expose the tonsil to view, the mouth dilator, invented by Mr. T. Smith, will effectually answer the purpose.

[The tonsillitome of Fahnestock is an instrument by means of which the tonsil may be removed safely and rapidly. It consists of a ring composed of two plates between which are inserted a circular knife and a stylet. The ring is slipped over the hypertrophied tonsil and pressed well back towards its base, the stylet is pushed forward through the body of the gland, and the knife is then quickly retracted and the instrument removed, when the projecting portion of the tonsil will be found transfixed by the stylet.]

In the adult, there is no difficulty in the operation such as may be encountered in children. The gland can be at once seized with a vulsellum, and a portion rapidly cut off with the knife. If both tonsils be enlarged, and this is usually the case, there is no objection to a portion of each being removed on the same day. With children it is preferable to do so, as the fear of an operation is much greater when

[1] Kölliker has given a minute account of the pathological conditions of the tonsil, and the abnormal secretion of the gland under such changes; but as any transcript of his investigations would not add to the practical importance of this subject, we beg to refer those interested in the question to the original, Manual of Human Histology, vol. ii., p. 30 (Sydenham Society).

a child has had any experience of a previous one. But in an adult it may be left to the discretion or wishes of the patient, whether the operation be completed at

[Fig. 349.

Fahnestock's tonsillitome.]

once, or at a subsequent period. If the tonsils are very large, it is always advisable to take away a considerable portion of each. But it is by no means requisite to remove the whole of the projecting mass. If half of the mass be removed, and the cells thus laid well open, what with their becoming emptied, the relief occasioned by the incision through parts chronically inflamed, and the subsequent contraction of the cut surface by cicatrization, the portion that is left shrinks and sinks into the side of the fauces, to give no further trouble to the patient.

After the removal of the mass, the patient generally suffers but little; or rather as one affected with slight sore throat. The precaution to be given is, to use soft food, and to avoid exposure to cold for a few days, when the cut surface will be about healed. [Marshmallow lozenges often give great relief to the patient if he suffers from painful deglutition after the operation.] Hemorrhage rarely follows to any troublesome extent on this operation; but it may, and sometimes does occur. [Mackenzie recommends the use of a strong solution of tannic and gallic acids in water, to be slowly sipped and swallowed in cases of troublesome hemorrhage.] The surgeon, always anxious to avoid such a contingency, should take the precaution, when operating, to draw as much of the gland as he conveniently can well into the cavity of the mouth inwards and forwards, so that a large portion may be seen projecting from the attached base; not more than half of the mass need be removed, and even as much as this only when the tumor is of considerable size. Such a portion will always be found sufficient for the ultimate relief of the patient, and the removal of all the previous disagreeable symptoms. In the practice of the author, such a proceeding has never been followed by troublesome hemorrhage. Should hemorrhage occur, iced water as a drink, or the mouth kept open for a time, may control it; or digital pressure may be requisite.

In children, hemorrhage may be suspected only after it has continued some time, from the cheeks becoming pallid, and the little patient showing signs of faintness. If, on examination, any distinct vessel is seen to bleed, a ligature can be applied with a little care; or recourse must be had to pressure, if the bleeding is from the general surface.

We need only refer to the proposal to remove enlarged tonsils by the application of ligatures, to condemn the plan of treatment as tedious, painful, and productive of much offensive discharge, until the slough separates.

3. *Tonsillitis maligna.* — Ulceration of an acute form attacking the tonsils, and rapidly running into sloughing of the fauces, is a very grave—often a most intractable—affection; and as rapid as it is unmanageable.

Sore throat is the first symptom complained of, and with it the patient probably expresses himself as feeling ill. Rigors, followed by feverish disturbance, will generally supervene. The tonsils will soon be observed to be of a dusky-red color, and swollen; and the surrounding soft tissues and uvula are already œdematous. There will generally be much pain, and some difficulty in deglutition. Patchy shreds of gray or yellowish membrane appear embedded in the surface of

the tonsils. These, after a time, spread, unite, and become deeper, until a considerable portion, if not the whole, of the soft palate may become implicated in the spreading mischief. The discharge which accompanies this form of slough escapes freely from the nose; for as the havoc spreads, the passage of even fluids to the throat is rendered difficult, and is often entirely intercepted by the œdematous state of the cellular tissue below the root of the tongue—so that liquids taken by the mouth are rejected through the nostrils. The character of the discharge is usually most offensive and intolerable. The room has to be kept well aired, and a constant and liberal use made of solutions of chloride of soda or lime, to moderate the fetor occasioned by the discharge.

If the patient survives, large sloughs separate from the parts attacked, and a considerable granulating surface may soon be observed, marking the havoc of the disease which has passed. In this havoc the whole of the uvula, and a considerable portion of the soft palate, have been seen to disappear, the patient's health being subsequently perfectly restored; though there remain for life the permanent defect, the alteration of the voice, and the inability to articulate distinctly—the results of the local injury to the soft palate.

[A form of pharyngeal and tonsillar ulceration usually coming under the care of the surgeon is that occurring during the early secondary stage of syphilis. At this period the entire lymphatic system is engorged and obstructed by the passage through it of the degenerated cells which, so far as is known, constitute the *contagium* of syphilis. This obstructive trouble is seen everywhere throughout the body in the enlargement of the lymphatic glands, the inguinal, epitrochlear, and posterior cervical being especially noticeable. The tonsils practically belong to the lymphatic system, the surface of each follicle being entirely covered by a network of dilated lymph-vessels, and, indeed, the whole pharynx is much richer in lymphatics than the surrounding mucous membrane. As these lymphatics, owing to their superficial distribution, are in more intimate communication with the bloodvessel system than are the ordinary lymph-glands, so the engorgement in them is more liable to run on to inflammatory and ulcerative action, and hence, we have the syphilitic sore-throat of the roseolous period or that of early skin eruptions. These facts have been well set forth by Dr. Otis, in his Lectures on the Physiological Pathology of Syphilis.

This form of ulceration is usually very superficial, involving hardly more than the epithelial layer of the mucous membrane, and yields readily to the use of mild astringent gargles and the internal administration of mercury. The syphilitic sore-throat which goes on to deep ulceration with sloughing and extensive loss of tissue, and which so often involves the hard palate in its ravages, is found only in the later periods of syphilis, is associated with the nodes, gummata, and bone and periosteal troubles of these periods, depends probably upon mechanical pressure due to the accumulation of cell elements, a result of changes produced in the lymphatic and other tissues during the evolution of the disease, and, finally, requires for its cure the immediate and free exhibition of iodide of potassium, either alone or combined with mercury.]

In the greater portion of severe cases of malignant sore-throat, the probability is, that they are specific, or only a type of the severer forms of scarlet fever. But still the surgeon's experience may be sometimes advantageously referred to in some of the stages of such cases; and for this reason we have taken a brief notice of them.

As in sloughing of other tissues, so in that of the throat, under all circumstances a stimulating and tonic treatment must be pursued; wine must be freely given; and with children, the muriated tincture of iron in full doses may be most advantageously administered. It is most efficacious as a tonic in such cases; can be given in small bulk; and, with the addition of a little syrup, forms a mixture children do not object to—a desideratum of no small importance in their management when sick.

A superficial and less severe form of ulceration of the tonsils is a very common occurrence. "Ulcerated sore-throat" is a term so familiar, and a condition so well understood among the more industrious and often over-worked students of our hospitals and dissecting-rooms, that it requires but little description here. Pain and some difficulty in swallowing; a creamy tongue; soft, weak pulse; pallid face; loss of appetite, and often loss of sleep; much languor, and pains in the limbs; tonsils congested, and somewhat swollen; small, irritable, superficial, and scattered ulcers on the fauces and tonsils: such are the chief symptoms found to accompany one of these attacks.

The treatment is well understood. Change of air; a stimulating gargle; a slight aperient if requisite; (mercurials, however, to be generally avoided); the internal administration of bark and ammonia, or chlorate of potash; and a nutritious fluid diet, with a few glasses of wine daily. Convalescence is generally satisfactory under such treatment. In all of the more acute inflammatory and ulcerative actions affecting the throat and tonsils, the internal administration of chlo-

rate of potash, as well as its free use as a wash or gargle to the part, appears to be attended by marked benefit. A lotion of the permanganate of potash is also most agreeable in such cases; for, as a gargle, it leaves a very pleasant taste in the mouth, and rapidly renders inodorous offensive discharges. It may with safety be used largely as a gargle or wash in all throat affections. So also a gargle of a weak solution of carbolic acid.

"Relaxed uvula" is by no means an uncommon complaint. The term does not quite describe the actual state of the parts in their altered conditions; for the uvula may be thickened and not increased in length. Under such circumstances it occasions but little annoyance, and seldom requires attention. Or it may be lengthened without being thickened, and this is the most common evil; and then surgical interference is necessary.

[It sometimes occurs as a result of general relaxation of the muscles of the palate and fauces, due to cerebral paralysis or to diphtheria. In these cases the arches and fauces are relaxed, the isthmus is diminished in size, and there are occasionally slight stertor and some regurgitation of fluids through the nose on attempt at deglutition.]

The increase of size, or the elongation, appears to be as independent of the condition spoken of under the name of enlarged tonsil, as the two conditions are of each other.

The increase of size is usually accompanied by a thickened state of the mucous membrane, and often by slight tenderness of the part. Though the thickening may remain, tenderness after a time will subside; and then the part is left in a permanently enlarged, though not in a persistently enlarging, condition. It seldom increases to an inconvenient size.

Should the symptoms which attend the first increase of size be troublesome, the simplest local remedy is to smear the surface once or twice with the solid nitrate of silver; and constitutionally to use such measures as the general condition of the patient will indicate to the observant practitioner. Usually the condition is one which is benefited by tonics. Elongation of the uvula appears to be generally dependent on an excess of mucous membrane; for the azygos uvulæ muscle does not often form any part of the increased growth. The mucous membrane may extend an inch beyond the extremity of the muscle, and hang down like a thin narrow slip of tissue, ending often in a point. When of this length, it dips into the pharynx, and the point rests over the aperture of the larynx. This contact with the larynx keeps up a constant source of irritation, and occasions a troublesome cough. Frequently the tickling of the fauces and pharynx produces nausea and a tendency to vomit. Patients sometimes, after food, on coughing, reject a portion of the meal taken. These symptoms are often attributed to other causes, until the throat is examined and the condition of the part detected.

This elongation of the uvula is not often seen in children, but most frequently in the period of middle life. It is seldom observed in old age.

The treatment is as simple as the relief is certain. Removal by knife or scissors is the only treatment to be entertained for a moment. The point of the uvula is to be seized with a long pair of forceps, and cut off so near to the base as to leave the part of its natural length.

The patient may feel the throat a little sore for a day or two, but no treatment beyond ordinary care will be requisite. The uvula is very apt to be implicated in inflammation about its neighborhood; and constantly, under such circumstances, becomes œdematous. This condition, however, is seldom confined to the uvula alone, but implicates usually the soft palate and adjacent tissues. It depends on erysipelatous or diffuse inflammation of the cellular tissue—a dangerous and often fatal affection, which will be found treated of in the essay on DISEASES OF THE LARYNX.

[Cancer of the tonsil occasionally occurs, the encephaloid being the commonest form of the disease. It is usually unilateral, occurs in middle age, invades surrounding parts, and may be known by its purple color, irregular surface, and rapid growth. Dr. Agnew has seen only one example of scirrhus and two of sarcoma affecting this gland. An operation is justifiable only when the disease is confined to the tonsil, which should then be removed through the neck by an external incision.]

Tumors of the soft palate and fauces are sometimes met with of a non-malignant character, and independent of inflammation. These usually consist of, 1. Fibro-cellular tissue; 2. Cysts; 3. Warty growths of a non-malignant character, occasionally met with attached to the soft palate, and growing apparently from the mucous membrane.

It has occurred to the author to have to remove such growths in two instances in young women; in both, the growths commenced without being noticed, and were accidentally discovered; they were readily removed, and were found to consist of simple epithelial structure.

1. The small fibro-cellular tumors usually assume a pendulous character. They

are painless; usually attached to the free border or upper surface of the soft palate; and are generally only detected when they become locally inconvenient by dropping down below and behind the root of the tongue. They are usually somewhat slow in their growth, and as they increase in size become more pendulous, often supported by quite a thin pedicle. They can be readily removed with scissors and forceps.

2. *Cysts* of these parts commonly contain a thin glairy fluid, generally the result of obstructed muciparous ducts. They are readily treated by a simple free incision, and a subsequent application of solid nitrate of silver, or a drop or two of nitric acid, applied on a probe to the interior of the cyst. [Cohen, quoted by Agnew, mentions a case in which a central cyst of the tonsil was the cause of nervous aphonia.]

Sebaceous cysts are occasionally found in the substance of the soft palate. They may be recognized by their yellowish white color showing through the mucous membrane. They only require to be laid open, and the interior of the cyst touched for a day or two with a probe dipped in nitric acid.

Abscess of the soft palate is rare; but it should be opened as soon as detected. It generally gives no subsequent trouble.

Congenital Fissure—"Cleft Palate"—and Defects of the Palate from Disease or Accident.

The occurrence of congenital fissure of the palate is so frequent; the evils which result from it are so marked; and the life of an infant is so often endangered and not unfrequently cut short, when the fissure is extensive—that a consideration of the treatment which proposes to overcome or to modify the defect, may truly be said to form a subject worthy of notice in a work on Practical Surgery.

The investigation of the early development of the mouth, explains the various degrees of extent which congenital fissure of the palate *may* assume, and such as *are* constantly found to exist in the newborn infant.

To Mr. Goodsir[1] the profession is indebted for an accurate account of the development of the mouth; and although, in a practical work of this character, it would be intrusive to enter very fully into such a subject, we are compelled to take a cursory view of the changes which occur in the upper jaw *in utero*, in order to clear up to a certain extent the causes of the various deformities which affect it.

In a fœtus of about the sixth week, examined by Mr. Goodsir, the cavity of the mouth, nares, and pharynx formed one undivided space; the palate was entirely wanting; the outline of the future alveolar ridge was evident. With the particular description of this latter process we need not trouble the reader; but from the inner margin "a thin, semi-transparent membranous fold passed backwards on each side, attached externally to the sides of the capacious bucco-pharyngeal cavity, bounded internally by a free edge, opposed to its fellow of the opposite side, and terminating posteriorly on the lateral walls of the pharynx.

"These folds constituted, at this period, a partial division of the large common nasal, buccal, and pharyngeal cavity into a superior and inferior compartment.

"The upper wall of this common cavity was smooth and flat posteriorly; but anteriorly it was contracted, and terminated in a longitudinal bar (the future septum nasi), which ran forwards to be attached to the superior surface of a horse-shoe lobe[1] (described) at the median line (in front) and to the other parts in that neighborhood.

"Under the bar a deep cavity was seen, which communicated with the exterior of the face by two small foramina (the orifices of the nostrils), which constituted at this period the whole external nasal organ."

In an embryo of about the seventh week, next examined, "the cleft had slightly diminished, but was still of sufficient width to display the whole of the undivided nasal cavity."

In an embryo of the second month "the cleft of the palate had diminished, existing only as a small angular deficiency in the pendulous portion, or soft palate."

In an embryo of the tenth week, the anterior portion of the palate "had thrown itself into folds; and there was an indistinct uvula."

The uvula "was well marked between the eleventh and twelfth weeks."

If an examination be made of the bones of the palate previous to, or not later than, the sixth month of fœtal life, in addition to the median suture between the palate-processes of the superior maxillary bones, a distinct oblique suture will be observed, which starts from the median suture a little behind the alveolar ridge, runs outwards and forwards through the latter, and terminates on its anterior aspect, at the point subsequently marked by the interval between the lateral incisors and canine teeth. So that in fact the under or palate-surface of the superior

[1] Edinburgh Med. and Surg. Journal, vol. li., p. 1.

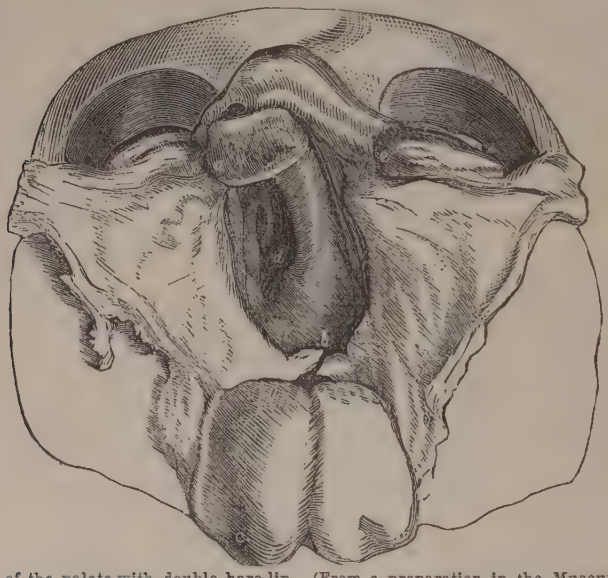
[1] This may be taken as the future "os incisivum" or intermaxillary bone.

maxilla is at this period of life (third to fifth month) marked by this suture, as if the bone had been at an earlier period divided into two portions: one, an anterior small "intermaxillary bone," or "os incisivum," as it is termed, and which carries the incisor teeth; and a posterior, the larger portion, in the alveolar process of which are developed the canine, biscuspid, and molars. [The intermaxillary bones "assist in forming no inconsiderable portion of the sockets for the incisor teeth; that they do not completely form them is a fact occasionally confirmed by the imperfect character of the sockets which lodge these teeth in those cases of cleft palate which have the intermaxillary bones isolated from the superior maxilla."] This suture disappears, under healthy natural development, soon after, or even before, birth. [In young bones it can always be seen, and is in fact usually traceable in bones of any age.]

The variations met with in the deformities of the palate appear to be distinctly due to an arrest in the development, already described, of the upper jaw and soft palate—an arrest which occurs from some unexplained cause, at an earlier or later period, but probably within the first twelve weeks of fœtal life, in accordance with the extent of the deformity. The variations may be thus classed:—

1. The most extensive; a double cleft of the alveolar ridge[1] with a fissure from each cleft running backwards and inwards, and joining together immediately behind the intermaxillary bone, and being continuous with a median fissure through the entire hard and soft palate.

Fig. 350.



Complete cleft of the palate with double hare-lip. (From a preparation in the Museum of St. George's Hospital.) *a*. The intermaxillary bone. *b*. The septum nasi. *c*. The tongue. *d*. The cleft into the nasal cavity. *ee*. The separated halves of the upper jaw.

2. A single cleft of the alveolar ridge on one side or the other of the median line; running back into an entire cleft of the palate.[1]

3. The alveolar ridge entire; the cleft of the palate commencing immediately behind it and complete backwards.

4. The cleft running as far forwards as the middle of the palate-processes of the superior maxillæ, or through the palate-bones only.

5. Fissure of the whole of the soft palate, or only implicating the uvula.

Between the extreme of one and the other every gradation of extent may occur.

Occasionally, but rarely, a congenital defect is met with in the median line, either as a circular or oblong opening: in front and behind it the palate is closed. These openings most frequently occur in

[1] Instead of the alveolar ridge being cleft, as described in this variety, there may be only a notch, or a large or small foramen through its base. The cleft has been partially closed by growth, or by pressure of the lip.

[1] The cleft of the alveolus under such circumstances is often complete throughout on each side from front to back, and from the mouth into the nostril.

the palate-bone; and usually, when such an opening exists, the median line of union is very plainly marked on the under surface of the soft palate and the uvula, by a distinct straight thin cicatrix, showing the union of the sides of the soft palate completed, although the palate-bones, in consequence of their defective development, were unable to perfect the naso-oral septum in their immediate neighborhood.

It will be observed in some cases that the gaps through the alveolar ridge are excessive, *i. e.*, complete from mouth to nostril; while in other cases they are but partial. When excessive, and when the fissure is complete through the hard and soft palate, the intermaxillary bone, or "os incisivum," becomes often widely separated from the superior maxillæ, and forms a nodule more or less round (the horseshoe lobe of fœtal life already described), which is supported by and attached to the anterior inferior termination

Fig. 351.

Double hare-lip, showing the intermaxillary bone attached to the septum nasi.

of the septum nasi. This nodule may be more or less prominent, and is occasionally so much so that it appears simply to be stuck on to the tip of the nose. Under these circumstances it is but little covered with skin, which is merely a prolongation from the integument on the apex of the nose, and unconnected with the integument of the lip on either side.

If the nodule be dissected between the sixth and eighth month after birth, in it will be found not only the temporary incisors, but also the germs of the permanent ones; not always the lateral, but invariably those of the central incisors. Occasionally those of the lateral will be found, though they frequently are sacrificed by the freak played by nature in permitting these gaps to occur.[1] Whenever a single fissure occurs through the alveolus, the gap will not be found in the median line, but, as a rule, on one side or other of it. We cannot satisfactorily explain this. It may depend on the peculiar conformation of the upper jaw and its early development. We would refer those interested in the subject to the further consideration of Mr. Goodsir's observations.

It is rare indeed that the infant born with extensive cleft palate and alveolus has not also the upper lip notched or fissured opposite to the defect in the bone. Usually, if not invariably, when the cleft of the alveolus is double, the cleft of the lip will correspond; when single, the lip is usually similarly affected. But when the cleft of the alveolus without cleft of the palate occurs, hare-lip is not always present.

In complete cleft of the roof the attachment or disposition of the septum nasi varies in different cases. As a rule, the more extensive the gap, the greater the deformity. The septum will often be seen, in complete cleft of the palate, to be continuous by its lower border with the margin of one or other of the edges of the cleft; in which case one of the nasal cavities is so far shut off from the mouth, while the other is open to it. In other instances the septum dips down between the nasal fossæ almost as low as the edges of the fissure, and terminates in a free defined border, unconnected with the superior maxillæ; or it will be sometimes seen bent or folded on itself, its edge turned up to one side, with one of its lateral surfaces facing downwards.

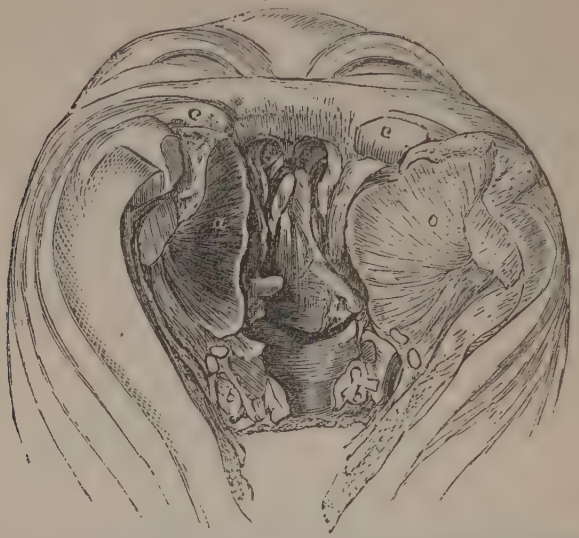
These different conditions of the septum have no practical bearing on the subsequent treatment of the case. Rokitansky alludes to fissures of the palate caused by the absence of the os incisivum, and attended by fissure of the upper lip *in the median line*;[1] but he does not state that he had met with an example of this rare de-

[1] When this nodule is very prominent, and appears likely to interfere with the success of an operation for the closure of hare-lip, we would strongly urge the importance of depressing it forcibly rather than removing any portion, or the whole of it. It may be forcibly broken and depressed, and made to fit in the gap between the superior maxillæ, where it will almost invariably become firmly fixed, and subsequently have shooting out from it some or all of the incisors. If these be defective, the surface of the bone forms an excellent rest for a plate to carry artificial teeth. If the os incisivum be removed, the superior maxillæ are certain to be more or less drawn together by the action of the upper lip, the latter to become much flattened, the upper portion of the mouth much narrowed, and the gap in the alveolar ridge never entirely closed.

[1] Rokitansky, Pathological Anatomy, vol. ii., p. 3.

formity. Sir Wm. Fergusson,[1] in alluding to the occurrence of cleft in the lip, says: "Doubtless it has been named hare-lip from a certain resemblance to the fissure in the upper lip of the hare; but in the human subject it differs in this peculiar feature, that it never is in the mesial line, as it always is in the hare."

Fig. 352.



Fissure of the palate in the median line. (From a preparation in the Museum of the Royal College of Surgeons.) *a a*. The tongue divided in two in order to expose the cleft. *b b*. The larynx similarly divided. *c c*. The two halves of the upper lip and jaw, between which is the cleft opening freely into the nasal cavity, the intermaxillary bone being absent.

Rokitansky only alludes to the occurrence of the fissure in the median line, but gives no details of any peculiarities which might be supposed to accompany such a defect. Sir W. Fergusson had apparently not met with a case; and the deformity is no doubt most rare. But a specimen such as Rokitansky refers to—the result of absence of the os incisivum and fissure in the median line of the upper lip—may be seen in the Museum of the Royal College of Surgeons in London. In this preparation (of which no history is recorded), the fissure of the upper lip is in the mesial line, the result of a great gap, as if a large portion of the middle of the lip were destroyed; the os incisivum is altogether deficient, no vestige of it being present; and the cleft of the hard and soft palate is complete.

But there is this additional interesting feature in this remarkable specimen: the anterior nasal apertures are wanting. The explanation of this latter defect appears to be simple. The os incisivum being absent, the septum nasi has nothing to attach itself to in front and below. The anterior orifices of the nostrils are therefore defective; the apex of the nose does not project; the alæ are flattened; and as the *entire* floor of the nares is deficient, and the anterior lower portion of the septum terminates by a free edge, the would-be anterior orifices of the nostrils are merged in the median gap of the lip, alveolar ridge, and mouth. Probably the child was stillborn, or died soon after birth.

We do not attempt to enter into an explanation of the causes of cleft palate. We possess no data to justify the pretence that observation has thrown any light on what may reasonably be considered an arrest of development at some period of fœtal life prior to the fourth month. But the cause of that arrest is shrouded in mystery, and is one of those aberrations in the function of nutrition and growth, to account for which is entirely beyond our present knowledge.

Thus much, however, we may state, that in the isolation of the os incisivum from the superior maxillæ, we find an approach to a somewhat similar arrangement in the teeth of the upper jaws of certain animals, in whom the incisors are separated, by a distinct interval or gap, from the bicuspid or lateral teeth.

[Dr. Shorthouse, who says he received the idea originally from Mr. South, asserts that men with cleft palates are almost invariably sterile. This non-fecundity, he says, does not extend to the weaker sex, women with cleft palate breeding as well as their more developed sisters. He says it is also a fact that cleft palate is about seven times as frequent in females as men.]

Cleft palate and cleft lip are frequently

[1] Practical Surgery, p. 584.

found to affect more than one member in a family; but we cannot state that congenital cleft of the mouth or lip is a common occurrence, as a result of hereditary transmission. It is rare to observe both the parent and offspring affected on either side, although brothers and sisters of the same family constantly present different conditions of the deformity.[1]

[In one recorded case a grandmother and two grandchildren had cleft palate and single or double harelip. The actual presence of the deformity in a parent seems to have very little influence in producing it in the offspring, and still less frequently is it caused by any maternal impression during pregnancy. Oakley Coles says: "In most of the cases which have come immediately under my notice, where one of the parents has had cleft palate, all the children born have been perfectly developed, even though dread of transmitting the deformity was constantly present in the mind of the mother." In many cases cleft palate is associated with other anomalies of development, but we often find it when every other organ in the body is perfect. So, too, although there seems to be a certain relation between palatal malformation and defective development of the brain, there are yet many cases in which it is found in conjunction with the highest degree of intelligence. Dr. Langdon Down has observed actual defects of the palate in one-half per cent. of his cases of congenital idiocy, and has found, also, in such cases a markedly diminished width between the posterior bicuspids of the two sides, with inordinate vaulting of the palate. There can be little doubt that there exists a definite relation between a high state of civilization and the frequent occurrence of palatal deformity, statistics abundantly proving this assertion; but whether this is due to a departure from a natural diet—as has been assumed by some writers to be the case in the instance of the lions mentioned in the foot-note—or whether it is the result of increased nervous strain affecting the parent and transmitted to the child as an actual imperfection of a nerve centre[1] is as yet a matter of speculation.]

Practically, the more extensive the cleft in the palate, the wider it will generally be found, and the more upright will be the surfaces forming the sides of the gap. Usually the cleft in the palate is narrower in front, and widens towards the velum. But much variety will be found if a large number of cases are compared with each other. In some the gap will be very wide; in others, though it be complete from alveolus to uvula, the gap will be very narrow. When the cleft is only partial, the less it encroaches upon the hard palate, the more natural will be the arch of the roof in front; and the sides of the partial cleft will also somewhat partake of the natural curve of the arch rather than run upwards, as is almost always the case when the cleft is considerable, or extends entirely through the palate and alveolus. Though the extent of the cleft be restricted to a small portion of the palate-bone and the soft palate, it by no means follows that the cleft is equally narrow in proportion; on the contrary, it will be frequently found that these partial clefts are very broad; so much so in some instances, that the palate processes of the palate bones and the sides of the bifid soft palate appear to be almost wanting. These partial clefts have been found to present, in some few instances, the greatest breadth met with; even to such an extent, in one or two instances, that operative interference was considered unjustifiable, as there did not appear, even of the soft palate, sufficient tissue to allow of the edges being brought together by suture.

The primary effects of cleft palate, when extensive, are sufficient to create much necessary alarm for the safety of the infant's life. If hare-lip exist, with double or single cleft of the alveolus, and a broad cleft of the roof, unless the infant be supplied *plentifully* with its mother's milk from the first, it will probably soon sink from exhaustion. It is very difficult in such cases to introduce a sufficient quantity of milk into the stomach, to insure an amount of nutrition equal to the maintenance of life. The mother's milk is the only food that should be given for the first six or eight weeks. In all cases of cleft palate, the infant is unable to suck the nipple: for as the naso-buccal septum is wanting, the child cannot create with its tongue a vacuum in the mouth, and is therefore unable to draw the ducts of the mammary gland. There is no alternative but to hand-feed such

[1] How far civilization or crowded populations may influence congenital deficiencies in the human subject, is a question to be hereafter worked out; but it is a curious fact, that most of the young of the lions caged in the Zoological Gardens of London are born with defective palates, and consequently die soon after birth. As far as our limited means have enabled us to ascertain, it appears that it is not usual for the lion family, in a state of confinement, to have their young similarly affected, but that this congenital defect is restricted to the lions kept in the Regent's Park, as if some local influence were instrumental to this end.

[1] Notably the trigeminus nerve centre. Anstie—quoted by Coles.]

an infant. It will be found most convenient to place the infant in the upright posture while it is fed; this position allows the fluid nourishment to flow backwards and downwards into the pharynx, instead of running into the nares and out of the nasal apertures, as is often the case when the child is fed lying on its back.

After a few weeks of this careful nursing, the child will begin to take its food with greater facility; and as it grows older, with a freedom which is somewhat surprising when the amount of defect in the palate is considered. But as these children have often a very great struggle for life in the earlier weeks, we repeat that *breast-milk should be alone given.* The milk should be drawn from the mother or nurse, and given with a bottle, to which a smooth flat ivory pipe is attached; its orifice should be small; and the flow of the milk through it so managed that suction is not requisite, but at the same time the current be gentle, and easily regulated by the inclination of the bottle in the nurse's hand; or a small piece of sponge dipped in the milk and then placed in the mouth, will often be found to answer equally well, but of course the process requires to be repeated as often as the milk is sucked out of the sponge. [An artificial nipple should be attached to the feeding bottle, and to the former should be fastened a flap of elastic India-rubber made to fit the roof of the mouth. The pressure of the nipple against its under surface when in position converts it into an artificial palate-piece and prevents the escape of the milk into the nose in the effort of swallowing.] So much as regards the early nursing of a child born with cleft palate.

The question now to be considered is, whether any treatment may be desirable to alter, or improve, by surgical interference, the condition of the mouth; and if so, what that treatment should be, and at what age such treatment may be safely and successfully put in practice. In the first edition of this work, we stated our opinion that it was not desirable to attempt to close the fissure of the palate, by operation, during infancy, and that such treatment was better deferred to a later period, when the patient was old enough to judge for himself whether he would prefer to wear an artificial palate for life or have the fissure permanently closed, and was moreover of an age to submit to an operation without the aid of chloroform.

Since that time, however, the experience of others, as well as our own, has induced us to materially alter our opinions and practice in this respect.

Mr. Thomas Smith, of St. Bartholomew's Hospital,[1] was, we believe, the first to introduce the use of chloroform in operations on the palate in children; and he has entirely proved that under its administration clefts of the palate may be readily and successfully operated on in childhood at a very early age. Prior to the publication of Mr. T. Smith's observations, other surgeons had succeeded in closing such clefts in young children;[2] but Mr. Smith, in addition to the information he has given to the profession, that chloroform can be satisfactorily employed in such operations with considerable advantage to the surgeon, has also, it may be said, still further perfected the steps of the operation, and rendered it one of comparative ease and simplicity, by the introduction of his ingenious gag for keeping the jaws asunder while an operation is being proceeded with (see p. 509).

There is no doubt now that treatment by surgical interference may be had recourse to, to close the cleft, long previous to puberty; but we are of opinion that the surgeon should still be somewhat guided by the age of the child, as to when the operation should be performed.

The real object of the operation of closing the cleft in the palate is to enable the patient to articulate hereafter, plainly and intelligibly—*not* to enable the child to take food.

[Even when the result of an operation seems to be perfect, there very often remains a disagreeable tone of voice, which is said to be due to the want of development of the parts in the region of the naso-pharynx, and to an unnaturally free communication between those cavities. Mr. Coles claims that nature has to some extent endeavored to remedy the defect in this region by the growth of what appear to be nasal polypi, but are really adenoid bodies. In over one hundred and seventy cases he found them present, attached to the anterior portion of the nares, the back of the pharynx, or between the turbinated bones; they are usually in pairs, but when single are found associated with complete fissure. They are different in character from the bodies frequently found in the naso-pharyngeal cavity, and described by Kölliker, and should not be confounded with the hypertrophied glandular bodies (adenoid tissue) of Luschka. Mr. Coles believes them to be identical with the growths described by Mayer as "adenoid vegetations."]

[1] Trans. Med.-Chir. Soc., vol. li., p. 79.

[2] In one case operated on by M. Billroth, [then] of Zurich, a cleft extending from the lip to the uvula was closed by successive operations before the age of twelve months. See Billroth, in Langenbeck's Archiv, vol. ii., p. 657.

An infant with extensive cleft, when first born, has often some difficulty in taking sufficient food to satisfy its wants, or to nourish it, as it would be nourished were its palate perfect; but usually this difficulty is overcome in a few days, and if proper care be taken the infant usually thrives. An operation at this period is therefore not requisite, nor is it desirable: the loss of blood the infant would sustain in such an operation would be attended by great risk to life; the tumefaction and tenderness of the mouth subsequent to the operation would be sufficient to interfere greatly with the infant taking a proper amount of nourishment; and both the loss of blood and the insufficient quantity of food might materially interfere with the union of the flaps, even supposing the infant does not sink under these circumstances. A very slight loss of blood may prove fatal in a very young infant, especially in one of a puny delicate nature, such as children with cleft palates often are; but the loss of blood in an operation for cleft palate is often severe, more especially when the hard palate is dealt with; great risk would therefore be run by the very early application of this operation, and fatal results would inevitably occur in many cases.

Dr. Ehrman,[1] in a very interesting and complete memoir on the subject of cleft palate, mentions the deaths of four cases, in infants in whom the operation on the hard and soft palate had been attempted —one of four days old, one of five days, and two of two months each. As a child does not commence to articulate, as a rule, before twelve months old, nor to pronounce many words before two years of age, there is no imperative haste for the adoption of the operation before that age, nor is there any advantage to be gained by its earlier completion. The reasons are strong against its performance prior to this period of life; some few months later, the child is in a much more favorable condition to undergo the operation, and less liable to succumb from the effects of loss of blood. Under all these circumstances it is safer, and ultimately equally efficacious, for the improvement of the articulation, to defer all operative interference until the child is two or three years of age.

[An operation for closure of cleft in the hard palate, originated and practised, we believe, by a Dublin surgeon, and later with some success by Dr. Garretson, consists in paring the soft parts and bone on both sides of the fissure, beginning on the approximal faces of the palate bones and cutting forward, and, after the bleeding ceases, applying a curved clamp with pads fitting the buccal faces of the alveolar arch, and gradually approximating them by means of a screw. After the removal of the clamp the parts are retained in position by the application of two stout compresses placed just below the malar bones and held there by an occipito-labial cravat, or a hard rubber truss, the spring resting on the top of the head and the pads on the buccal compresses. This operation when performed at all should be undertaken as early as possible after birth, when the bones are in their softest condition.]

With the use of Mr. Smith's gag and the administration of chloroform, the operation may now be undertaken without hesitation, can be readily performed, and in a large majority of cases will be successful. In children with entire cleft of the hard and soft palate, we recommend the closure of the soft palate as the first step in the operation. If this be successful, the aperture left in the hard palate will in most cases diminish considerably in the course of some few weeks. Dr. Ehrman mentions this to have occurred in cases under his observation, and we can confirm his experience by our own. It is, in fact, one of the great advantages of an early operation on the soft palate, that when successful the continued action of the muscles behind the maxillary cleft tends to approximate the edges of the latter; similar to what is observed to take place in any extensive gap in the alveolar ridge after the fissure in the upper lip has been some time closed.

As the most simple form of cleft is that confined to the velum or soft portion, we propose to consider, first, the method to be adopted to close it, irrespective of any extension of the fissure into the hard palate.

Should the uvula alone be bifid, very little is requisite to secure union of its opposed edges; and indeed, if the voice be not affected, nor the cleft detected by any peculiarity in the articulation, it is better not to meddle with the fissure. Cleft of the uvula, however, usually affects articulation. The surgeon need have no hesitation in undertaking the operation. The opposed edges of the bifid uvula should be pared, care being taken to carry the incisions on either side a little way into the soft substance above, so that they meet in the median line in front of the commencement of the cleft; care must also be taken that the mucous membrane at the edges is sufficiently removed to insure two raw surfaces being adapted to each other. The surgeon should first seize one point of the bifid uvula with a pair of long spring forceps, and draw it forwards, transfix it near its inner border with a narrow sharp knife on a long handle, and freely cut upwards and downwards, in order to remove the

[1] Étude sur l'Uranoplastie. Paris, 1869.

mucous membrane along the whole of its inner margin. A similar proceeding on the opposite side completes the use of the knife. A couple of sutures will be sufficient to approximate the edges and keep them in place.

Mr. T. Smith observes with respect to the material to be used for sutures, that he has found fine fishing-gut best adapted for the soft palate in the young; or horsehair for the lower part of the velum and uvula; both these substances, if soaked for a few minutes in water, will become sufficiently supple for use.[1]

In the experience of the author, fine silk is as efficient for the purpose of sutures as any other material, and is preferable to most. Such sutures are readily introduced, and very readily removed. The latter is not a point of trivial importance, and is an advantage when the soft palate is concerned, which does not equally apply to metallic sutures. The author has invariably used silk sutures in all operations for cleft palate, and with the most satisfactory results; nor has he, from the experience and experiments of others, seen any good reason to prefer any other material.

When a cleft extends forwards through the whole of the velum, or even to a slight extent into the palate-bones, the operation is rather more complicated than that above described; and though not beset with any difficulties, requires a careful examination into the anatomy of the soft palate, and some little familiarity with the operation, before the surgeon can be confident of obtaining that success, which should usually follow attempts to close a cleft palate by surgical interference.

That the edges of a wound should meet without any traction on its margin by sutures, is a fundamental rule which applies generally to all plastic operations; but especially is it absolute in any operation to close a fissure of the palate, whether in the hard or soft portion.

If a fissure of the soft palate be carefully examined, and with the mouth open the patient make an attempt to swallow, the action of the muscles of the pharynx and tongue is such, that the edges of the fissure are approximated by the action of the superior constrictors; the extremities of the bifid uvula touch, and often the gap is for an instant closed to one-third or one-half of its extent; but immediately afterwards the sections of the soft palate are drawn back to the walls of the fauces; and often the whole of the soft palate itself is so closely contracted into the side of the fauces, that a superficial observer might conclude, in some instances, that no soft palate existed. This latter effect is the result of the combined actions of the levator and tensor palati muscles contracting towards their attached extremities, and thus drawing up the sections of the velum. So that every attempt to bring the edges of the fissure together would be opposed by these muscles, on either side, pulling away from the median line, and consequently drawing directly away from the line at which the edges of the fissure should meet to insure union.

Having experienced this evil, and at once seizing on the cause of the failure, which then so constantly attended attempts to close the fissures of the soft palate, Sir W. Fergusson proposed the division of these muscles prior to the edges being brought together. In a paper published in the Transactions of the Royal Medical and Chirurgical Society, he fully describes the method he adopted to ensure this result. Since Sir W. Fergusson promulgated his views, this operation has been commonly undertaken, and, thanks to his suggestion, has been followed by a large share of success. Sir W. Fergusson recommends the division of the levator palati on either side by cutting, with a knife bent at a right angle, behind the curtain of the soft palate. The division of the muscles is thus most effectually secured. He also recommends that the palato-pharyngeus be divided on either side. In able and experienced hands, to cut with a right-angled knife, behind the palate, where the point of the knife is out of sight, is a simple matter; but there are few surgeons unaccustomed to these operations, who feel at ease in using such a knife in such a situation. Having observed this, it occurred to the author, some few years back, that the levator muscles could be as readily divided by cutting through the palate. The experiment made on the dead body at once proved the extreme feasibility and facility of thus being able to divide these muscles; since then every case which has come under his care has been thus treated, with the most satisfactory results. The method of procedure is very simple. First a suture is passed through one section of the soft palate at the root of the uvula, the ends secured together by a knot, and held outside the mouth. A second suture is then passed through the opposite side at a corresponding point. One of the sutures, now firmly holding one-half of the soft palate, is drawn gently forwards and to its opposite side, so that the section of the palate is well stretched towards the median line. A thin, narrow, sharp-pointed knife, fixed in a long handle, is then introduced into the palate, close to the hamular process, a little in front and to its inner side. This

[1] Trans. Med.-Chir. Soc., vol. li., p. 85.

process can be distinctly felt in the substance of the soft palate, internal and a very little posterior to the last molar tooth. Running the knife upwards and backwards, and somewhat inwards, the point may at last be seen in the gap, having passed through the entire thickness of the soft palate, and having cut, if not wholly, at any rate partially, through the tendon of the tensor palati: the knife should now lie above most of the fibres of the levator. If the handle of the knife be next raised, the point becomes depressed; and if the blade be drawn forward, while it is at the same time made to cut downwards, it travels through a considerable section of a circle on the posterior surface of the palate, and insures the division of the greater portion of the levator palati. As the knife-blade travels downwards, the tension of the palate gives way, and often the division of the muscle is felt to be suddenly effected; the ligature being no longer pulled upon by it, though previous to division it will be felt sensibly and spasmodically contracting. As the knife is withdrawn through the wound, the division of the levator muscle should be thoroughly effected. The wound, in the front of the palate, need be no more than the width of the knife; whereas the wound behind is necessarily much longer, for the fibres of the levator have there to be divided by the sweep of the knife. Provided the muscle be effectually divided, as soon as the knife is withdrawn it will be found that all voluntary and involuntary movements of the palate have ceased; it has become pendulous and flaccid; pulling on it now should produce no spasmodic contraction of its fibres. Should any resistance still be observed, the knife must be again introduced through the anterior wound, and the fibres a little more freely cut in a downward direction.

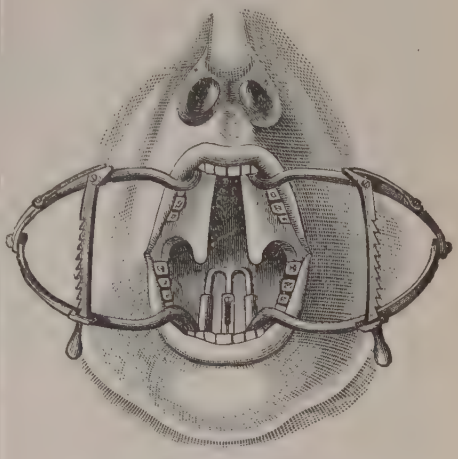
The muscles having been divided on both sides, the sutures, used for the purpose of holding the flaps, should be removed, that they may not be in the way of the operator.

The edges of the cleft have next to be pared. The knife already used will answer for this purpose; and there appears this advantage in the above method of operating, that *one knife suffices for the entire operation.*

Great care is requisite to free the edges sufficiently of their mucous covering: it is better to remove a little more than requisite, than an insufficient quantity; for the success of the operation is not interfered with in the former case, whereas the operation will most certainly fail to some extent in the latter condition.

[Previous to beginning the operation it is best to fix the tongue and hold the mouth open by means of one of the many instruments devised for that purpose. (See fig. 353.)]

Fig. 353.



Whitehead's gag and tongue depressor.

[The edges may be pared from before backwards by transfixion, the angles being freshened later; or the cut may be made from behind forwards so that the blood may not obscure the line of incision; or they may be split as has been done by Drs. Packard and Cohen, of Philadelphia; or the fissure may be surrounded with an inverted /\ incision, the flaps being left attached at their lower angles and the wound assuming after the dropping of the flap a double <> shape.]

Though Sir W. Fergusson recommends the division of the palato-pharyngeus muscles, the author has of late satisfactorily operated on several clefts of the soft palate, without having divided those muscles or touched them with the knife.

The completing stages of the operation consist in passing the sutures through the flaps, and securing their edges in contact with each other, until union has been efficiently established. Two or three fine curved needles, on rather long handles, should be ready, armed with fine white silk, slightly waxed. [Fine silver wire is usually employed by American surgeons.] As soon as one needle has been used, it can be again armed, while another is in the hands of the surgeon. It is best to decide at first how many sutures may be requisite; and also to observe carefully the points at which they should be introduced; so that when all are passed, their positions in each half of the palate may correspond, in distance, from each other, as well as in their distance from the margin of the wound; and also that those on

one side should be directly in line with those opposite. The sutures, in each needle handed to the operator, should be at least a yard in length; and each suture should be doubled, for its whole length, before being passed. The surgeon, with the needle in the right hand, and a pair of long spring-forceps in the left, should now push the point of the needle through the soft palate (on the patient's left side) as near to its anterior margin as practicable; for although this, the highest suture, is not intended to approximate the edges of the cleft so that they should touch, still, by slightly assisting to narrow the cleft, it adds much to the utility of the one below when the operation is completed. For the reason stated the upper suture should be passed rather near to the palate-bone.

The point of the needle having been passed through the palate, should now be pushed inwards, until it becomes visible through the cleft: one thread of the suture is then to be seized with the forceps, and gently drawn forwards, *through* the fissure and out of the mouth; the needle should then be withdrawn, care being taken that the suture is left running through the palate, and each end secured outside the mouth. The second needle should now be introduced on the opposite side, in exact line with that on the left. When the point appears in the gap, the silk should be seized with the forceps; and *on this side*, in drawing out the suture through the fissure, care must be taken by the surgeon to draw out *the entire loop*, and not simply one thread of the suture, as on the opposite side. The loop must be drawn forwards gently, until secured by the forefinger of the operator, when the needle may be disengaged from the rest of the suture. There should then be on one side through the palate a single suture; on the opposite a double suture, the loop of which corresponds to the inner side of the fissure. The *inner* end of the single suture is to be passed through the loop of the double suture a short distance, and the ends of the latter gently pulled, until the whole double suture is withdrawn from the palate, and with it has pulled into the corresponding portion of the velum half of the single suture; and this now should lie across the fissure, with each end passed through a section of the soft palate. These ends of the suture should be secured outside the mouth, until all the succeeding ones, as many as may be required, are placed and secured in a similar manner. One is usually required for the lower portion of the uvula.

As soon as the requisite number have been introduced, each should be separately tied; carefully, so as to adapt the edges evenly to each other; and not too tightly, that room be allowed for subsequent swelling of the soft tissues. If the sutures be tightly drawn, they most certainly will cut themselves out by producing ulceration of the part through which they pass. A slip-knot to bring the edges together, and a second knot over that, are sufficient to secure the suture, and maintain apposition until union is safe. The ends of the sutures should not be cut off very close to the knots: otherwise, when the silk becomes thoroughly sodden with moisture, the knots are almost certain to become loosened or untied in a very short time, and much too soon for safety.

Mr. Callender has recommended the division of the muscles a day or two prior to an attempt being made to close the palate; thus the operation is divided into two stages. He urges, and with good reason, that by dividing the muscles on one day, and paring the edges of the fissures and passing the sutures on a subsequent one, the second operation is much simplified by the freedom from that bleeding which takes place whenever the muscles are divided at the same time that the cleft is pared and the sutures passed.

Mr. T. Smith's method of operating is, first to pare the edges of the fissure from below upwards, then to pass the sutures, and lastly, "to draw up the palate with all the sutures in one hand, and with the palate on the stretch to divide, if necessary, the palato-pharyngeus, and subsequently the levator palati; if the palate will not come easily together, two lateral oblique cuts may be made, one on either side above the highest suture, separating the soft from the margin of the hard palate to a small extent."[1]

The operation for closing the hard palate is a very different proceeding to that described as requisite for the relief of fissure of the soft portion. The result of some experience confirms the opinion long entertained, that, when fissure of the hard as well as of the soft palate coexists, the attempt to close the entire fissure in one operation is not advisable. Separate operations, at some short intervals, should be had recourse to, so as to close either the hard or soft portions first, and the remaining portion subsequently. There are several cogent reasons to render such practice generally desirable. In the first place, an attempt to close a fissure of the hard and soft palate at once entails a long and painful operation on the patient; and as he has to keep his mouth open while the operator is at work, it becomes a most tiring and irksome effort, if the period is a prolonged one. In the second place, the loss of blood which will often occur, in an operation on the hard palate alone, is sometimes considerable; often

[1] Trans. Med.-Chir. Soc., vol. lii., p. 84.

apt to make the patient faint, and so prolong the completion of the operation. But should the attempt be made to close the hard and soft palate at once, the loss of blood is usually much greater, and often too great to allow of perfect success in the attempt. In the third place, when an attempt is made to close the cleft in one operation, the edges of the soft tissues both in front and behind are apt to ulcerate, and often to slough.

If the soft palate be alone operated on, some ulceration may and does often supervene; but it is rarely of such consequence as to be ultimately of any importance, provided the palate has not been unnecessarily bruised or cut about. Under the circumstances above alluded to, the integrity of the tissues covering the hard palate contributes largely towards the nutrition of the somewhat injured soft palate; but if a large portion of the attachment of the soft tissues covering the bone be interfered with by their separation from the latter, not only is their intrinsic nutrition greatly reduced, but they can, by so much the less, aid in preserving the vitality of the soft palate, while its union and reparation are becoming established. If, however, the soft palate be first selected for closure, and the operation be successful, the union of the flaps converts the anterior portion of the fissure into a foramen; and *pro tanto* aids in the nutrition of the soft tissues of the hard palate, when they are detached from the bone, at some subsequent operation; or if the hard palate be operated on first successfully, so much is gained in front, to assist in the nutrition of the soft palate, when it comes under the knife of the surgeon. As before stated, the operation on the soft palate aids to contract the gap left in the hard palate, even without further operation; and this will be observed in the adult, but especially in the child.

Complete fissure of the hard palate, or one extending to or near the alveolus, is generally closed without much difficulty. The most simple method of detaching the soft tissues from the bone, and of forming the flaps which are to close the gap, is first to make the lateral incision, on either side of the cleft. This incision should be close to and parallel with the alveolar ridge, and extend from a point opposite to the last molar forwards to the canine tooth. The flaps may now be separated from the bone by an instrument with a somewhat broad and rather blunt edge slightly curved inwards. The separation should be commenced from the incisors and proceed inwards, terminating when the edge of the gap is attained. The separation can be quickly effected without much risk of bruising the flaps; or the soft tissues may be separated from the bone, by the operator commencing at the edge of the cleft and dissecting outwards. Of late we have, however, adopted the former method of proceeding, and find that the separation of the flaps from the bone can be more readily and effectually accomplished, with less risk of bruising, or cutting through the substance of the flaps. This is a matter of great moment for the ultimate success of the operation; for should the flaps be much bruised or torn in the process of their separation from the bone, ulceration or sloughing is most apt to supervene and materially interfere with the union requisite to the success of the operation.

The flap detached from the bone should consist of all the soft tissues covering the latter—mucous membrane, areolar tissue, and periosteum. If the soft tissues are separated from the bone in the manner recommended, on the dead body, it will be found difficult (and we conjecture equally difficult in the living subject) to peel off the thick mucous membrane without the subjacent periosteum. The operation which Professor Langenbeck proposed, and to which he gave the name of "the operation by muco-periosteal flaps," appears to be identical with the method of operating introduced by Mr. Avery.[1]

[Sir William Fergusson, in 1873, revived Dieffenbach's plan of cutting through the hard palate in its entirety on either side of the fissure with a chisel, and bringing the segments of bone, and of course the sides of the cleft, into contact by means of wire sutures. He had treated eighty-two cases in this manner up to the end of 1875, and with remarkable success. Mason suggests perforating the bone at several points so as to prevent comminution during the use of the chisel. This may be done advantageously with a surgical engine.]

Mr. Annandale[2] has succeeded in closing fissures of the hard and soft palate by the adoption of lateral incisions merely, and without the division of the muscles of the velum, either in the manner adopted by the author or that which has long been recommended and practised by Sir W. Fergusson. But in the cases related by Mr. Annandale he carried the lateral incisions back some way into the substance of the soft palate. His results were perfectly satisfactory—so much so, that his method of operating in extreme cases of fissure may probably, upon more extensive trial, supersede those already described and at present most commonly adopted.

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[1] See Prof. Langenbeck's treatise entitled Weitere Erfahrungen im Gebiete der Uranoplastik mittelst Ablösung des mucös-periostalen Gaumenüberzuges Berlin, 1863.

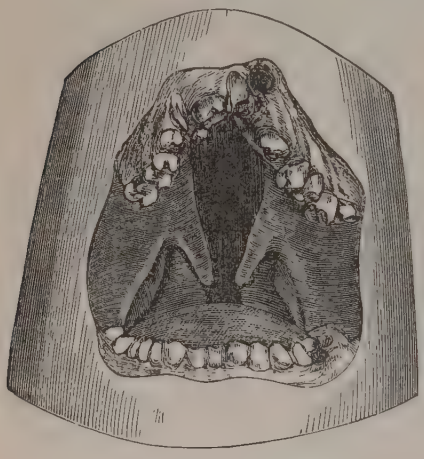
[2] Edinb. Med. Journ., 1865, vol. x., p. 621.

When the soft tissues have been effectually separated from the bone, the flaps should fall inwards and downwards and meet in the median line, without the slightest traction being requisite. If the edges do not readily touch, the flaps have not been sufficiently detached from the bone on one side or the other; and care must be taken to ascertain the point which prevents their sufficient descent, and this should be freely liberated; nothing must be allowed to interfere with the free approximation of the edges.

When the fissure is extensive, and more or less complete, the free separation of the soft tissues from the bone is amply sufficient to allow the margins of the flap to meet easily in the median line; occasionally they will overlap; in which case, the edges require to be carefully adjusted. They should be carefully pared with a sharp knife, so that if a little ragged, they are made even; and the possibility of any mucous surface becoming insinuated between them be avoided, and the contact of two entire and fresh raw surfaces be insured. The sutures are to be passed as already described. There is often some trouble experienced in passing them through the anterior part of the palate; but care and patience will usually overcome any difficulties which may present themselves.

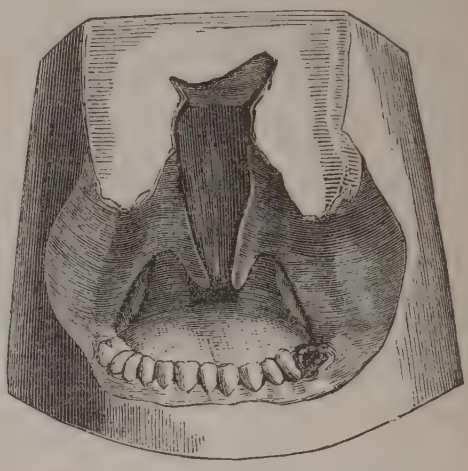
When a fissure of the hard palate is complete, or nearly so, the sides of it will be found to approach more or less to the perpendicular in their direction, as is shown in figs. 354, 355. The result is, fortunately, that when the soft tissues are sufficiently detached from the bone, the flaps fall inwards and downwards, and readily meet in the median line; there is always ample material to permit of their arching over the defective roof, when they are once liberated from the bone.

Fig. 354.



Drawing from a model of a complete cleft of the palate (St. George's Hospital Museum).

Fig. 355.

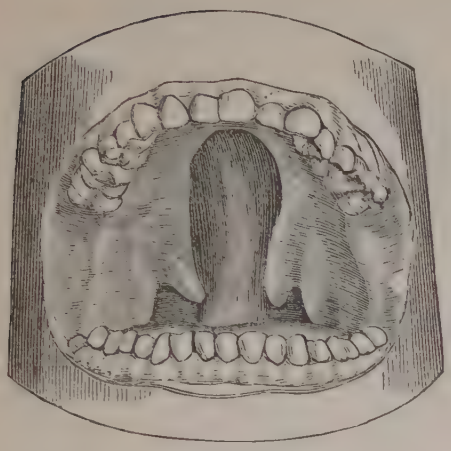


The same model cut in two to show the perpendicular direction of the sides of the gap.

But when the fissure in the bone is confined to the posterior half, the portion of the palate in front of the fissure, and whatever portions of the palate-processes exist at its sides, will be observed to approach, in curve, the arch of a perfect palate, as seen in figs. 356, 357, taken from the model of a cleft of this kind; the bony fissure will often be broad, and rounded in front; and the membrane covering the bones very thin. In such cases, if the soft tissues are merely detached from the bone at the sides and front of the fissure, there is not much spare surface to close the gap; consequently the edges of the flaps do not meet in the median line, so readily as occurs when the tissues are detached from the more upright sides of more complete fissures. Often, however, a fissure of the posterior half is narrow, pointed in front, and its sides covered with thick velvety mucous membrane. Under such circumstances little difficulty is experienced in getting the edges together.

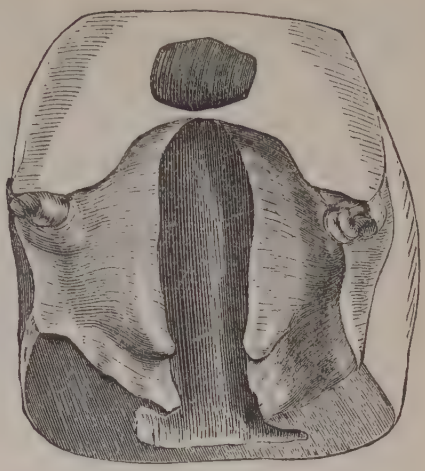
When cases with broad fissures of the posterior half of the hard palate are operated on, it is generally necessary to make lateral incisions through the soft tissues, parallel with the edges of the fissure, and close to the alveolar edge. The soft tissues between the incisions and fissure must then be separated from the bone; but great care should be taken not to injure the anterior or posterior extremities of these flaps, or in any way damage their connection in front and behind; the flaps

Fig. 356.



Drawing from a model of a partial fissure of the palate (St. George's Hospital Museum).

Fig. 357.



The same model divided, showing the much more horizontal direction of the sides of the gap.

must then be fastened together with sutures. Sometimes it will be found desirable to plug the incisions with a little soft cotton: this helps to push the flaps towards the median line, and takes off some of the traction of the sutures; this traction being almost unavoidable in instances in which the gap is an unusually broad one.

Such cases as the latter are the most unsatisfactory to deal with. In some instances it will be found best to close the soft before attempting the hard palate; for experience has taught us that the continued action of the muscles of the soft palate, closed by operation, has always a tendency to contract any opening left in the hard palate.

If the gap left should appear too large to be benefited by a subsequent operation, it would be better that the patient should use an artificial palate; at any rate, until from lapse of time the ultimate benefit of the first operation can be estimated.

It frequently happens that, under the most favorable circumstances, and with the greatest care on the part of the operator, a small pin-hole aperture, or fissure enough to admit the flat end of a probe, will remain at the meeting-point of the hard and soft palate. Under such circumstances a metal plate should be worn for a period, *over the opening*, to prevent the percolation of saliva and other fluids through it. Under such treatment it has a tendency to close. But if any substance, such as a plug, etc., be made to project continually *into the opening*, and thus press on its margins, it will invariably and gradually increase in diameter; in time the plug will become useless, and must be replaced by a larger one, and this will be followed by progressive increase in the size of the aperture.[1]

If it should happen that a patient, with hare-lip and cleft alveolus and palate, should not have had the lip operated on in childhood, it will, in all probability, be found that the cleft of the alveolus is considerable,—sometimes sufficient to allow the point of the finger to be passed through it from nostril to mouth. Under such circumstances the first care should be to operate on the lip. It will be found, subsequent to the healing of the lip, that the action of its muscles, in a very short time, will have approximated the edges of the separated alveolar ridge, often so as to make them touch; though, in consequence of the interposition of the mu-

[1] The author would not be doing justice to the memory of the late Mr. Avery, in omitting to mention that he was the first surgeon in this country to close entirely a complete cleft of the palate. Since then the operation has been frequently and successfully performed in England and on the Continent. To Dr. Warren, of Boston, in North America, the profession is chiefly indebted for having advocated the closure of the hard palate by operation. In the New England Medical and Surgical Journal, and also in the American Journal of Medical Sciences, as early as the year 1843 (also in 1848), Dr. Warren gave the result of his operations on fissures of the hard as well as the soft palate. Although complete closure does not appear to have been effected in any of these cases by *one* operation (which Dr. Warren appears always to have had recourse to to close both hard and soft palate), yet his success by subsequent treatment in the management of these cases marks him as one of the pioneers in the advancement of this department of surgery.

cous surfaces, the chink between them never appears to be obliterated, unless the mucous membrane be removed.

Occasionally small orifices are met with in the palate, either congenital, or more frequently the result of some cachectic or syphilitic condition, terminating in necrosis and destruction of a portion of the bony palate. In either condition, some little difficulty will usually be encountered in attempts to close such orifices. In all instances, lateral incisions are requisite; and a repetition of the operation may be necessary, even more than once, before entire closure be effected. But, under any circumstances, should the opening be not ultimately filled up, it will generally be greatly reduced; so that the patient will be enabled, with the aid of an artificial palate, to secure himself from the discomforts attendant on a perforation of the roof.

Orifices through the soft palate are usually, if not always, the result of ulcerative action. Generally they close after a time, without the assistance of an operation. An opening, the result of strumous ulceration of the soft palate, and of the size of a sixpenny-piece, in a patient under the care of the author, contracted and closed entirely, after cicatrization of its margins had occurred, without operation or any surgical treatment. When, however, such an opening ceases to contract, and holds out no prospect of natural obliteration, but promises to be permanently patulous, its edges should be pared, lateral incisions made, and the margins brought together and retained in apposition by sutures.

The amount of blood lost during the performance of an operation on the palate will vary to a very great extent in different cases; but usually much more is lost in the process of detaching the tissues from the bone, than in the operation on the soft palate. The anterior and posterior palatine vessels sometimes bleed profusely after division; so much so, that occasionally it becomes necessary to make pressure for a few moments or more, with the finger; especially on the anterior, which generally bleeds more profusely than the posterior vessels. Iced or cold water should be used frequently, to wash out the mouth during the operation, when hemorrhage is free. The loss of blood in no one operation, under the experience of the author, has been attended by evil consequences. Women are often apt to faint from a small loss of blood, when added to the fatigue of the operation. In one instance which occurred to the author, the operation was obliged to be completed while the patient was lying on the floor.

It is advisable and often necessary, to administer stimulants liberally to the patient during the operation, not only to endeavor to obviate the effects of the loss of blood, but also to encourage one who flags in determination.

The patient should always be provided with his usual meal previous to the operation. For some days after, *he must be plentifully supplied with nutritious fluid and soft food;* strong beef-tea, bread and milk, tea with half milk or cream, strong soup, and beer or wine. From the first hour after the operation, strict attention to this rule forms an important element in the satisfactory union of the flaps.

It might be supposed by some, who have not experience in this class of cases, that, after an operation on the soft palate, the effort of swallowing would be an effective impediment to union, in consequence of the action of the muscles of the palate; but it must be borne in mind, in the first place, that, prior to the operation, the palate-muscles had no power in themselves to assist in the act of deglutition; they could not close, between the ori-nasal cavities, on the passing food; in fact, that the process of deglutition is initiated in the back part of this ori-nasal and pharyngeal cavity, by the extremely educated action of the superior constrictors of the pharynx. In the second place, the divided, and to an extent crippled, muscles of the palate are naturally passive in deglutition until reparation is established and complete. So, in practice, it is found that, as long as a patient is restricted to soft or fluid articles of nutriment, union is not retarded by the mechanical action of deglutition, however often he may be fed in the day. But if all diet be withheld, the patient's strength, already lessened by loss of blood, becomes lowered to such an extent, that reparation is rendered doubtful, and union of the parts is retarded, if not ultimately prevented. All hard food should be avoided for a week or ten days; such as solid meat, potatoes, dry bread, etc.

The sutures should not be permitted to remain in the flaps many days. Usually, in the soft palate, the two lower ones should be removed on the second day; and if there be four sutures, one of the two latter should be taken away each succeeding day: that which is highest, to be last removed. It has been supposed desirable to retain the sutures in the flaps for a longer period: but in each fresh case that comes under our notice, it becomes more evident, that if union is satisfactorily established, the retention of the sutures beyond the third or fourth day only tends to render it less effective: and if the condition of the edges of the approximated flaps is not satisfactory, and their union is not firm, the presence of the

sutures will aggravate rather than diminish the evil.

The patient should not be allowed to speak until union is complete, and the sutures are removed. He should be provided with materials for writing all his wants; a small slate and pencil will be found most convenient for such a purpose. It is not requisite to confine the patient to bed after the operation; but in some instances individuals prefer to lie still for a few days, especially if they feel weak from the loss of blood. The condition of the tongue, before or after the operation, must not be taken alone as indicative of the patient's condition. All persons afflicted with cleft palate are liable to a dry, rough, and often coated tongue—the result of the constant passage of air in respiration over the surface opposed to the fissure. The injury, from the operation, to the soft tissues of the roof, generally sets up a slight degree of feverish excitement, with a very coated tongue for a few days. This condition of tongue must not be taken to indicate the want of purgative medicine. In an instance under the author's notice, this state of the tongue was mistaken for a symptom of some great general disturbance of system, and to remove it, two consecutive doses of calomel were administered within four days of the operation: the patient became salivated a week after the operation, and the wound, which had been most satisfactorily united, gave way entirely under the salivation.

We cannot too strongly urge the point that, previous to any operation for the closure of clefts of the palate, the surgeon should first satisfy himself that the patient is in a condition of health to justify the expectation that "*union by first intention*" will follow the adaptation of the raw edges of the flaps to each other. The success of the operation depends on immediate union of the edges: if they do not unite at once, there is no hope that they will do so secondarily, when in the stage of granulation. We ought to be most particular not to recommend an operation, should the patient show any sign of disordered health or defective power—pustules, herpes, excoriated lips or nostrils; in fact any indications, trivial in themselves, and perhaps of no import in the balance which influences other operations, should in cases of cleft palate be decisive against operative interference until a clean bill of health can be written for the patient.

The particulars of the following case illustrate the importance of such a precaution. The author operated on a young lady ten years of age, and apparently in perfect health, for fissure of the soft palate. The operation was most satisfactory in its immediate results, the gap being entirely closed. The parts looked perfectly united on the second day; on the third day, the little patient was attacked with scarlet fever, and in a few days after, the whole line of union had entirely given way. The parents had brought this child from the country a few days previous to the operation, but had left another at home recovering from the effects of scarlet fever; and of this circumstance not one word was mentioned until after the appearance of the eruption subsequent to the operation.

It may be asked, what amount of improvement in articulation and speech is effected by the operation in patients who successfully undergo it.

[The prognosis as to the language and speech capacity of sufferers from palatal and maxillary deformity of congenital origin is a matter of great importance. Mr. Coles has made some interesting observations bearing upon this question, and which he epitomizes somewhat as follows: There is a definite relation between palate and cranium as to length, breadth, and probably also as to outlines. In palatal and maxillary deformities there is in a large number of cases asymmetry of the skull; in a notable number of cases this consists of a flattening of the left side of the cranium; language, speech, and sound-centres are on the left side of the brain; defects, injuries, and changes involving these parts produce defects of speech and language. Physical deformity of the skull is frequently associated with congenital structural defect of the brain. Certain cases of cleft palate or of other maxillary deformities, and having a deficiency in the articulate-sound-function, are also deficient in the articulate-sound-centre. These are advanced as hypotheses, and not as demonstrated truths. If they are ever substantiated their influence upon prognosis in this class of cases becomes evident.]

Dr. Warren states: "There is generally more facility of speech, which, so far as it has been in my power to watch patients at a distance, is constantly improving. A young man was present at a meeting of the Boston Society for Medical Improvement, about two years after the operation, and it was difficult to discover the least imperfection in his speech, although it had previously excluded him from society."[1]

The author has found that in many cases the improvement has been most marked and satisfactory; and, in almost all, sufficient to render what was unintelligible readily comprehended: in one case, a stranger could not have detected a defect in articulation, on the delivery of a long sentence, three years after the clos-

[1] Amer. Journ. of Med. Sci., April, 1848.

ure of the entire palate. In all cases time is requisite, and much pains must be taken by the individual to acquire the power to articulate clearly such letters and words as, without a roof to the mouth, the tongue cannot command. It becomes, in fact, a task to the patient to learn how to pronounce correctly and distinctly a new dialect. The condition of the upper incisors is often very defective in these cases of cleft palate: always more or less so when the cleft has extended through the alveolar ridge. Such cases should be placed in the hands of an experienced dentist, when the surgeon has terminated his work; for this irregularity of the teeth will often form a complete impediment to the improvement in articulation, although the palate may be most satisfactorily closed. The substitution of artificial teeth in front, in place of the defective ones often found in these cases, is not only of considerable assistance towards improving the power to articulate more distinctly, but also materially lessens a deformity so long a prominent feature in such patients.

It would be invidious to the task the author has undertaken, in writing this article, as well as deficient in respect to those who have devoted attention to the subject it refers to, were he, in conclusion, not to mention the names of Roux, Cloquet, Mettauer, Mütter, Pancoast, and Dieffenbach, with those of Warren, Avery, and Fergusson. Each has so far aided in turn, to improve this once apparently difficult and almost hopeless operation, that it can now be confidently looked upon as certain to effect closure of the most extensive cleft, and almost certain to improve thereby the most defective articulation.

Diseases of the Lips.

The congenital defects of the lips and of the mouth, and the treatment applicable to each, are described elsewhere in this work; as also the diseases of the tongue, and their treatment. In the following section will be described the diseases of the lips, jaws, and floor of the mouth.

The diseases of the lips are usually so marked, that they greatly affect the appearance of the individual; and they are often so serious, that they demand the most careful attention of the surgeon.

Simple "*cracked lip*," when superficial, may be the result of long-continued cold weather, acting upon a constitution somewhat out of order. The crack is usually near to, or at the middle of the lip; is not deeper than through the mucous covering; is often excessively painful when stretched, and readily bleeds if its edges be accidentally and suddenly separated. It may generally be relieved by slight attention to constitutional measures; an alterative, with aperients, if requisite, or such other remedies as the condition of the patient may indicate. The application of caustic will often relieve the pain at once; and some simple salve constantly applied keeps the surface soft and supple, and prevents its edges from getting dry and tender. [An ointment or an ethereal solution of iodoform is sometimes very useful in these cases.]

Should such a slight but painful crack be neglected in early life, and no measures taken to relieve the patient of this troublesome recurring sore, it will often happen that the crack deepens, and becomes more permanent in character; it becomes located in the part; and appears sometimes so deep, that it might be supposed that the middle line of the lip had been grooved out by ulceration; a very unsightly furrow, occasionally of considerable depth, is thus formed, to the great deterioration of the personal appearance of the individual. Under such circumstances, the relief, which in former years would have been readily obtained, is now no longer so available; for though the ulcerated base of the furrow may heal under judicious treatment, it will leave a chink or gap in the middle of the lip; and nothing short of paring its edges will remedy it. Under these circumstances, an operation may be recommended and undertaken, should the patient be in any degree desirous to have the disfigurement remedied. The edges when pared should be brought together with one or two fine sutures.

Slight superficial fissures, indicated by thin white lines, are occasionally to be observed on the upper and lower lips, in children as well as in adults; presenting an appearance as if at some former period slight ulceration had existed, though now healed and sound. If the teeth in the child be examined, they will be usually found to mark the characteristics of congenital syphilis; and occasionally other symptoms of hereditary taint will present themselves, or may be detected as having existed. These marked fissures of the lips have been constantly observed to be associated with an inherited stain.

Cracks of a severe character are generally observed in the under lip; but fissures are not at all uncommon in the upper one. These usually occur in children, and are mostly associated with, if not always indicative of, a scrofulous constitution; enlarged cervical lymphatic glands are constantly present in such children. Such a condition of lip is often obstinately persistent, and can only be

combated by such measures as are advisable for the improvement of the general health. If very painful, an occasional application of a strong solution of nitrate of silver will relieve the extreme sensibility, for this will be sometimes very distressing in the movements of the lips: indeed so much so occasionally, that it interferes with the ready and comfortable use of the lip in conversation or during eating.

Fissures or ulcers of the commissures of the lips, or of their inner surfaces, should be very carefully looked to. In children they are usually transient, innocent, and associated with some passing constitutional disturbance; or more obstinate, and grafted on a strumous habit. [Congenital fissure of the angle of the mouth, or macrostoma, is occasionally met with, and should be treated by freshening

Fig. 358.

Macrostoma. (Ashhurst.)

the edges and bringing them together with hare-lip pins or with numerous fine sutures.] In adults, or after the period of childhood, such ulcerations or cracks about the commissures must be regarded with extreme care and some suspicion, under apparently the most innocent and unsuspicious circumstances; as a rule, they are the results of former syphilitic taint, and form one of the numerous varieties of secondary syphilitic affections; other indications, confirmatory of such contamination, will seldom be found wanting [often a pustular or pustulo-squamous eruption will appear on the cheek near the corner of the mouth, and still more frequently superficial ulcerations of the sides of the tongue or of its under surface near the frænum will be found]; and the condition of the part will be subservient to the treatment adopted for the general condition of the patient.

A troublesome, and often a recurring evil, which the practitioner has to combat, is the tendency, in some persons, of inflammation of the mucous membrane of the mouth to run into aphthous ulcers. Such ulcers sometimes become deep, and may be some days before they assume any tendency to heal. They occur on the side of the tongue, on the lips, and frequently on the frænum of the tongue. They are always painful, sometimes exquisitely so; and their extreme tenderness may last many days, though the ulcer itself be not more than the flat surface of a split pea. The ulcer is generally ashy on its surface, as if covered with a superficial slough of mucous membrane; the surrounding membrane is red, and slightly swollen.

These ulcers, whether aphthous or more extensive, are generally attendant on some constitutional disturbance. In some individuals they constantly recur; and in such persons, either some peculiar defect in health, or perhaps some local climatic or other influences, may be their exciting cause. [They may be an evidence of a general cold, and in some individuals result from prolonged exposure to the sun.] The pain of the ulcer can be at once relieved by touching the surface gently with a point of nitrate of silver. It is as satisfactory as it is unaccountable, to observe how immediately the application of this caustic removes the often exquisite pain—pain which may render the patient almost unable to eat or talk. The ulcer usually ceases to be felt after the caustic is once applied, and heals without further trouble; a second application is rarely requisite.

[No other local means are worth considering. The writer has employed the whole list of sedatives, astringents, alteratives, etc., but without the slightest beneficial effect, either in relieving pain or in cutting short the disease. The only objection to nitrate of silver when the ulcers are upon the lip is the transient disfigurement which it causes by reason of the blackness of the superficial slough formed by it.]

The constitutional measures must be guided by the circumstances of the case, as the recurring form of ulcer is usually associated with a delicate state of health. Every attention must be given to the improvement and invigoration of the system. But medicine will frequently fail to produce that which change of air, soil, scene, and circumstances effect in a short time, and as frequently in an unexpected manner.

Vascular growths of the lips, etc.—The tissues of the lips and cheeks are favorite localities for the commencement of nævi, or vascular growths, whether of arterial or venous constituents. Such masses are unsightly at best, and are usually brought to the notice of the surgeon at an early period for treatment. The nature of the treatment is necessarily various; and the variety in treatment is dependent, in a measure, on the amount of the diseased structure. The nævus may be but

a small red superficial patchwork of vessels; or it may be a large soft spongy cluster of veins, spreading over a very large section of one side of the face. The small arterial bright vascular patches are most common; though often a very large spongy venous nævus on the cheek may be observed in very early life.

When a small arterial nævus occurs on the margin of the inner surface of either lip, and is entirely superficial, it may be disposed of in several ways; but the application of the ligature is the most rapid, the most certain, and not more painful than any other. [When seated on the margin of the lip they often form projecting

Fig. 359.

Arterial nævus of the lip.

pendulous growths which are very easily treated in this manner (fig. 359).] A needle passed through the base, and a fine ligature tied under the needle tightly round the mass, rapidly and surely effects its removal. In the course of a few days the slough will have separated; and in a few more, the wound, which at first may appear formidable after the removal of the slough, quickly contracts and cicatrizes.

If the diseased mass of vessels is larger, and dips into the substance of the lip, and has not spread laterally, but involves more in depth than in breadth, it may become a question whether it would be better to cut out the diseased mass, as in an operation for cancer of the lip, or to destroy it by the repeated introduction of ligatures through its substance, tied tightly, so that the mass be cut up into several pieces. If the mass involves the whole thickness of the lip and the corresponding surfaces of mucous membrane and skin, and, though extending towards the root of the lip, does not spread laterally, and can therefore be readily removed by incision, there are reasons for such treatment being preferred. The disease is at once got rid of; the relief is effectual; the operation is simple; the recovery is quick; and the scar left after union is but slight. The only precaution requisite in the performance of such an operation is to take care that the incisions are made through healthy tissue, and beyond the diseased vessels. The margins of the wound are to be brought together, as in the operation for hare-lip.

But rather than sacrifice skin or mucous membrane, if either or both are much implicated, it is far preferable to have recourse to ligature: if the disease spreads laterally, or extends in any degree into the cheek, ligature alone must be used.

Under the circumstances of ligatures being applied to such nævi of the lips and cheeks, it should always be borne in mind that scar must be avoided as much as possible, and mucous membrane saved as much as can be. The one is an eyesore; the loss of the other is apt to produce distortion of mouth and a contracted cavity. Therefore, in using a ligature for nævus of the face, it is best to pass the thread entirely subcutaneously, and to tie it at the common point, where it entered and emerged from the skin, so that no portion of the latter be destroyed. One ligature may be sufficient in slight cases; but in others several may be requisite to completely obliterate and destroy the diseased structure. The object to be kept in view in introducing the ligatures, is to effect the entire division of the diseased mass of vessels in several directions,—that, in fact, they be cut into several pieces; so that if, in the first instance, a ligature be introduced round a portion of the tumor, in the second operation one should be passed across; that each ligature should act on a fresh part; that ultimately the original mass may be divided into so many portions as will insure the consolidation of all the diseased tissue.

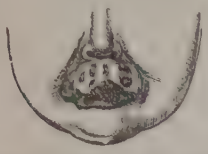
If the ligature be introduced on a needle at one point, and carried partly round the mass subcutaneously, and brought out at some distant point,—again introduced and carried in or through until it reach the original puncture, and the ligature then tightly tied at this opening,—no skin need be destroyed, or mucous membrane cut or damaged. Each ligature should be tied as tightly as possible. It will soon cut its way free. The ends of the ligature should not be left too short; otherwise they may become buried in the wound in the subsequent swelling of the parts, and probably would cause suppuration to a greater extent than desirable, or even occasion some difficulty or delay, from being retained in the wound. The more tightly the ligature is tied, the more speedy will be its release from the tissues which it grasps.

Vaccination should only be tried in very small nævi; the introduction of caustics, setons, the injection of perchloride of iron, each have their advocates; but none of these secure more effectual obliteration of the nævus than the ligature: they often fail to secure it as rapidly; they often set up more irritation than is requisite for the purpose in view; they sometimes cause the skin to slough; and

they are more painful in adoption, inasmuch as, being slower in action, their application must generally be often repeated before a satisfactory result is insured.

[Mr. Erichsen reports a case, of which fig. 360 is a front view, in which the nævus involved the entire upper lip and had commenced to extend into the nostril.

Fig. 360.



Nævus of upper lip and nostril.

The integuments covering the growth were exceedingly thin and the whole tumor was in the highest degree vascular and active. Potassa cum calce was employed and the tumor gradually destroyed, hemorrhage being controlled by pressure. The result was most satisfactory.]

The galvanic cautery has often been employed by the author; but after a great number of experiments in the treatment of such cases, he is satisfied that subcutaneous ligature will invariably be found quickest in action, most effectual in result, least objectionable as regards scar, and, so far, less painful than any other kind of treatment. This is the case whether a nævus of the lip be large or small; unless the case be more suitable for the knife.

[There is a peculiar hypertrophy of the lip, which has been described by Prof. Gross, and which is usually met with in young persons of the strumous diathesis. It effects almost exclusively the upper lip, which becomes two or three times its natural thickness, is hard and rigid, and sometimes shows a tendency to ulcerate. The affection is frequently accompanied by strumous manifestations in other portions of the system, such as enlarged tonsils and psorophthalmia. The firmness and induration of the lip, the absence of coexisting disease in the gums and teeth, and the chronic nature of the enlargement, together with the scrofulous appearance and condition of the patient, will generally make the diagnosis sufficiently clear. No operation is needed for its relief. Attention to the secretions, with some alterative medicine, or a mild course of mercury when other means fail, will generally be all the treatment required.]

Cancer of the lip may be said to be confined to the lower lip, it is so rare in the upper: it is certainly more frequent in males than in females, the proportion being relatively large in the stronger sex.

The characteristics of cancer affecting the lip deserve particular attention. As a rule, we may say it is found to consist of the epithelial variety.

"Epithelial cancer has its primary seat, with very rare exceptions, in, or just beneath, some portion of the skin or mucous membrane. Its most frequent locality is the lower lip, at or near the junction of the skin and mucous membrane."[1] Commencing sometimes as a small warty growth on the lip; sometimes as if the mucous membrane were excoriated, with the excoriation resting on an inflamed and thickened base; sometimes as a small, indolent tubercle: the condition, which does not at first excite suspicion, by degrees is seen to alter and the growth to increase. The wart grows in breadth and thickness; the excoriation becomes deeper, and rougher on its surface; the tubercle peels and ulcerates, scabs and peels again; until, sooner or later, the persistence of the mass, or the heat and pain of the part, attracts the more serious attention of the patient, and he then seeks for relief.

It is unnecessary here to enter upon the question of the pathology of cancer, or of its cachexia; the subject having already been discussed in the essay on CANCER, Vol. I.

We pass on at once to the consideration of diagnosis and treatment.

The diagnosis of cancer of the lip may at first sight appear simple enough; and yet a certain degree of caution must be observed, ere an opinion be definitely arrived at, as to the precise character of a hardened sore, or of a raised tubercle of the lower lip. It has occurred to the author, and no doubt to many others, to point out, that a previously supposed cancer of the lip was but a chancre: a chancre of the lip has been mistaken for the more serious malignant sore. The surface under both conditions may be superficially excoriated; the lip may be thickened at the part; the sore may rest on a hardened base; and there may be the additional suspicious circumstance of attendant enlarged glands in the submaxillary region. It must, however, be borne in mind, that cancer of the lip is somewhat slow in its progress; that the cervical glands do not usually indicate the more grave implication of the constitution at an early period; whereas in chancre the glandular enlargement would be apparent in six or eight weeks, at the latest, from the first appearance of the sore; and probably, if no specific treatment have been adopted, other evidences of secondary symptoms, such as eruption,

[1] Paget's Surgical Pathology, vol. ii., p. 412.

sore-throat, etc., would be manifest within six weeks of the first infection. As a mistake in diagnosis between cancer and chancre of the lip has often been known to occur, a few remarks, in passing, on that subject will probably not be thrown away.

Cancer of the lip is a disease of advancing, if not of advanced life; but man is often depraved, and experience teaches us that age need not be taken as a bar to the occurrence of a chancre of the lip.

A gentleman past the meridian of life, on whose head time had showered more than a few snowflakes, applied to the author with a condition of lip which had excited suspicions as to its cancerous character. The appearance of the sore itself was extremely deceptive; scattered and isolated glands, slightly enlarged, and hard, were to be felt in the submaxillary regions; and his position and circumstances in life rendered it most improbable that a chancre could have been contracted on such a part. This sore was found to be accompanied by a commencing faint lichenous eruption. The patient was put under a mild course of mercury, and rapidly recovered; the hardness at the base of the sore entirely disappeared.

The characteristics of the two affections may thus be summed up: chancre of the lip may occur at any period of life, and is as often seen on the upper as the lower lip. Youth is the most probable period of the infection; and, we say with regret, it is most frequently observed in women: it sooner or later forms a superficial sore, raised on a base of an almost cartilaginous consistence: the surface appears more like an excoriation than an ulcer; or the surface may have cicatrized and the hard base remain. The glands of the submaxillary spaces enlarge at an early period, some six or eight weeks after the sore commences; and though hard, small, and scattered usually, they sometimes attain a large size. In one instance which came under the author's notice, the glands on the right side were very much enlarged, and on the inside of the right half of the lower lip was a large hard mass of cicatrix, the original sore of which had entirely healed some weeks previously. Secondary symptoms will sooner or later appear, unless early treatment be adopted.

Cancer of the lip is a disease of advanced life; affects the lower lip mostly; is most frequent in men; does not progress uniformly, and usually slowly; does not implicate the absorbents at so early a period as chancre; does never thoroughly heal up and cicatrize like chancre. The disease is usually of the epithelial variety of cancer, and varies a good deal in its method of commencement, in its progress, its growth, and its appearance; while the characteristics of chancre are uniform in most persons. Cancer always contaminates the absorbents, if allowed to run its course unchecked; ultimately it destroys, locally, all tissues in contact with its surface; the whole lip may be affected; large cancerous masses exist, at the same time, from the symphysis to the clavicle; and death ultimately follows.

The treatment of cancer of the lip usually resolves itself into removal by knife, or destruction by caustic. In the opinion of the author, it should entirely resolve itself into that of the knife; and the earlier such treatment is adopted, the better the prospect of prolonging life.

The surgeon having decided to remove a cancer of the lip with the knife, the patient should be seated in front, with his head steadily supported by an assistant; or he may lie on a sofa. If the disease occupy but a small portion of the lip, the mass may be removed entirely by a V-shaped cut through the healthy structure. The lip may be transfixed with a thin straight knife, and then cut upwards on either side of the diseased tissue; an assistant should hold the flaps as they are liberated from the diseased part. The flaps are to be brought together with pins and the twisted suture, or by sutures alone; care being taken that the margins of the prolabium, or mucous edge, be accurately adjusted. One, two, or three pins may be requisite; some surgeons prefer sutures without the aid of pins; and silver sutures answer the purpose very satisfactorily. If pins be used, as soon as they are fixed by suture, the sharp points should be cut off, and the remaining ends so protected that they be not readily caught by the dress, etc., of persons in attendance, otherwise the patient runs the risk of being accidentally very much hurt, for want of a little foresight. In all these operations the pins or sutures should be removed at the end of forty-eight hours at the latest, and the wound supported by adhesive plaster.

If a large surface of the lip be affected, and the disease be superficial, it may be readily removed by a semicircular sweep of the knife, or a cut with a pair of curved scissors; in either case the opposed edges of skin and mucous membrane should be brought together with sutures. In the incisions through the lip, the labial arteries bleed freely. With the aid of the pins and twisted suture the hemorrhage is readily and effectually checked; with the semicircular incision a ligature or two may be requisite.

It will save some little inconvenience, and also pain, to have the sutures well oiled before they are twisted round the pins: by using this precaution, it will be easy to remove the sutures subsequently,

as they are readily detached from the pins; when not oiled, they adhere to the pins and to the skin, and always occasion pain when removed.

The use of caustics, in cases of epithelial or other cancers of the lip, is but waste of time, and an unnecessary infliction of suffering; provided the disease be not too far advanced for removal by the scalpel. The knife should always be used when practicable; caustic, only when the disease is too far advanced for removal by the knife. But even then it is doubtful whether any application of caustic, by retarding growth or destroying material, compensates for the pain, often exquisite suffering, which is inflicted by its use. It is a question worthy of consideration, whether caustics of any kind act beneficially in any cancerous affections. If caustic be decided on, the most efficient is the chloride of zinc, applied in the form of a paste.

The advantages of operating early can only be appreciated when compared with the more rapid results of a case which is allowed to run its course unmolested. But under the most favorable circumstances, we can only expect the operation of removal to relieve for a time; the disease usually returns, and generally shows itself in the glands of the submaxillary region. These in time increase to a great size; the skin over them ulcerates and sloughs; an ulcerated and fungoid surface discharges profusely, and often bleeds largely: and life is thus drained away. We cannot here more fully discuss the advantages of the removal of cancerous affections of the lip; but as such affections are not ultimately amenable to any treatment, nor the disease ever eradicated by topical remedies, their entire removal offers the speediest prospect of present relief; and though such a measure should be adopted as soon as the disease is decided to be cancer, the remedy is at best but a choice of evils, and must never be held out as one of radical benefit.

Cysts of the lip are not infrequent. They are generally observed near the free border, or inner surface, usually of the lower lip. They sometimes increase to an inconvenient size. On the margin of the lip they seldom project beyond the mucous membrane; the skin is usually free. They are generally well raised from the surface; covered by very thin membrane; usually transparent, but occasionally somewhat discolored and of a venous hue, as if veins traversed or opened into a cavity.[1] They contain either viscid clear mucus, much like the contents of the cysts termed ranulæ; or sometimes a darkish fluid of thick consistence. They are generally single, though their surface and shape may be irregular. They seldom grow large; though this may be the result of locality, as the surgeon is usually required to remedy the evil before it occasions much inconvenience, or becomes unsightly.

Such cysts are usually innocent in their character; do not recur in the part when effectually treated; nor are they congenital, unless of that variety alluded to as connected with bloodvessels. These cysts are often not larger than small peas, or from that to the size of a small walnut; painless; indifferent to being handled; and only inconvenient from size or disfigurement. They occasionally remain stationary for life; and are then usually small in size, and frequently discolored; the more transparent ones have the greatest tendency to increase, as if dependent on the secretion of a gland, which probably, having had its duct obstructed, has given rise to the formation of the cyst.

The treatment to be adopted in such cases is very simple, and usually satisfactory. The cyst should be freely divided, and its contents allowed to escape; when entirely emptied, it is best to wipe out the cyst with dry lint, and then freely apply strong nitric acid to the whole surface of the lining membrane. Though the treatment be rather sharp for the moment, the pain soon subsides, and the patient is then able to eat and talk as usual. No surgeon should be satisfied with simply puncturing such cysts; a puncture, or even a small incision, will frequently close before the cyst is obliterated; and in a few days it becomes as large as it was originally. Even after the application of nitric acid, unless the opening be free, and care taken to keep it so, until the cyst be entirely destroyed, the accumulation of fluid is very apt to recur. It is a good precaution to touch the edges of the opening with nitric acid for a few days consecutively, to ensure its not closing until suppuration be fully established, so that the cyst be obliterated. [A seton is very effectual and almost painless.] Occasionally a cyst in the lip is complicated with some solid growth. Such growths are usually somewhat of a granular nature,[1] and very favorable for removal. These tumors are not common. They resemble, to some extent, the mammary glandular tumors in consistence and character; or "they may appear intermediate between the foregoing and those tumors which are found over, or near, the parotid gland, and con-

[1] "Cysts formed of dilated portions of bloodvessels shut off from the main stream."—Paget, op. cit., vol. ii., p. 27.

[1] For a specimen, see Museum of St. George's Hospital; referred to also by Paget, vol. ii., p. 73.

sist of mixed granular and cartilaginous tissue."[1]

Mr. Paget refers to a case removed by himself from the upper lip of a man; and describes a second case, which occurred under Mr. Lloyd's care, in a man who had a tumor in his upper lip for twelve years, when it was removed. "The tumor was firm, slightly lobed, yellowish-white, smooth. In general aspect it resembled the mixed tumors over the parotid; but its minute structure presented as perfect an imitation of lobulated or acinous gland-structure as any mammary gland."[2]

Cysts of the mouth may be congenital, or the result of obstructed ducts; ranulæ; or possibly bursæ between the muscles of the tongue.

Congenital cysts of the mouth are not frequent, though they occur sufficiently often to be familiar enough to surgeons. Mr. Cæsar Hawkins long ago drew attention to their real character. Usually such cysts are single, and may increase to a large size; or they may be multilocular and numerous, and occupy a considerable portion of the floor of the mouth. Whether single or compound, they will usually be found between the lower jaw and the tongue; if large, pressing the floor of the mouth forwards and upwards, and the submaxillary soft tissues outwards and downwards.

An infant three weeks old was sent to the author by Mr. Frank Buckland, then assistant surgeon of the Second Life Guards. The mother found that the child suckled with increasing difficulty during the last few days, in consequence of a swelling on both sides of the floor of the mouth, which was pushing up the tongue, and had much widened the lower jaw. It had also encroached backwards so as to press somewhat on the larynx and pharynx; respiration was somewhat impeded; deglutition was slow and difficult. Under the tongue and on both sides of the mouth there projected a lobulated irregular cystic mass; some portions of which, especially on the left side, were so prominent, that the tongue was pushed upwards by it, and the tumor bulged out between the tongue and the lower jaw, to such an extent that the infant could not close its lips. An irregular lobulated swelling projected on each side of the throat, immediately below the lower jaw.

The cysts projecting between the tongue and lower jaw were thin and pellucid, the membrane covering them pale-colored, and free of vessels on its surface.

A seton passed through a cyst on the left side soon allowed it to collapse; a thin purely transparent fluid oozed out through the punctures. On other days other threads were passed through some of the more prominent cysts, while some were punctured. The partial reduction of the sublingual swelling enabled the infant to partake more freely of food, and for some days a slight improvement was observed in his condition. This was but transient; evidently other and deeper cysts became larger; gradual increase of dysphagia and dyspnœa supervened; and the infant died, greatly emaciated, the sixth week after its first visit to the hospital.

On examination, it was found that this cystic formation involved all the tissues between the mucous membrane of the floor of the mouth and the skin covering the submaxillary region; so that not only did the mass of cysts (it might be termed a multilocular cystic tumor) project upwards in the mouth, but downwards on both sides, in the submaxillary spaces. On a section of the tongue, the whole muscular structure was seen studded with cysts; small and millet-like in some parts, rather larger in others; some single, others multilocular. The larger ones were generally multilocular, with bands running across and around their walls.[1]

Other forms or characters of cysts are occasionally observed in the mouth, sometimes between the gum and the cheek.

Mr. Paget describes a case of this nature, which occurred in a woman, in whom a soft elastic swelling pushed out the thin mucous membrane of the upper jaw, producing externally an appearance somewhat similar, at first sight, to distension of the antrum. An incision into the cyst allowed the escape of nearly an ounce of turbid brownish fluid, containing crystals of cholesterine.

Cysts connected with defective development of teeth, "dentigerous cysts," usually confined to the alveolar regions of the maxillæ, are not uncommon. Their history and treatment are related by Mr. Salter, and will be found in the next essay.

[Occasionally an acute semi-fluctuating tumor will be found on the floor of the mouth, not apparently dependent upon any of the usual obstructive causes. This is the *sub-glossitis* of Earlhouse; it is a condition of local anasarca which commonly results from some irritative condition in the neighborhood, and disappears with the removal of its cause.]

Obstructions of mucous follicles occasionally give rise to the formation of mucous cysts, already spoken of; the obstruction of the submaxillary or sublingual ducts may be productive of the cysts termed "ranulæ."

[Ranulæ are always retention-cysts, but vary greatly in size and consistence. When the tumor is of recent formation the contents are watery; later they will

[1] Paget, vol. ii., p. 262.
[2] Ib., p. 263.

[1] The preparation is in St. George's Hospital Museum.

be found more consistent, inspissation resulting from partial absorption, and in still older tumors the contents may be entirely solid, consisting of material exactly like salivary calculus or tartar. The symptoms produced by a ranula are those due to its size and pressure on surrounding parts; in neglected cases of long standing, teeth having been forced from their sockets or necrosis of the inferior maxilla having been caused. The absence of the

Fig. 361.

Ranula; a seton tied in the tumor.

salivary secretion seems to have no prejudicial influence on the function of digestion. Ranula is very rare in new-born children. At the foundling hospital in Moscow, during the last seven years only four cases have been observed in about eighty thousand children. The treatment consists in the excision of a portion of the cyst-wall and cauterization of the edges of the wound, or in the introduction of a seton.]

Again, congenital sebaceous cysts are occasionally found among the tissues of the floor of the mouth.

A young woman was admitted into St. George's Hospital, under Mr. Hewett's care, with a considerable swelling on the right side of her mouth and neck. The swelling bulged into the mouth; had displaced the tongue to the opposite side; and protruded downwards in the submaxillary region. The swelling was painless, but inconvenient from its size; it had been many years forming, and it was doubtful whether it was congenital or not. A free incision through the portion projecting into the mouth, allowed the escape of a large quantity of a thickish yellow fluid most offensive and putrid in smell, similar to the contents of a suppurating sebaceous cyst. By degrees the cavity contracted and closed.

This patient returned to the hospital about three years afterwards. The cyst had again filled, and projected a good deal below the lower jaw. It was now opened by the author, in the neck, through the skin, below the lower maxillary bone; and a large quantity of offensive sebaceous-looking fluid was evacuated; a seton was then passed through the cyst, and retained several days, until the cavity had become perfectly contracted. The opening soon closed, and as far as could be ascertained, the cyst appeared to have been obliterated. The patient has not again shown herself; but promised to do so on the slightest recurrence of the swelling.

The diagnosis of cysts of the mouth is not often complicated: usually, fluctuation is very evident; as frequently, the surface of a portion of the cyst projects into and on one side of the mouth, so that it may be seen covered only by mucous membrane; the walls are thin and pellucid; the contents visibly transparent, or slightly tinged from some accidental circumstance or individual peculiarity.

In other cases these cysts present more obscure conditions: they may lie deep among the muscles of the floor; or may press backwards and interfere with the movements of the larynx or pharynx; or a sanguineous tumor may be mistaken for a cyst, though sanguineous tumors are exceedingly rare in these parts.

Such serous and mucous cysts as we have referred to, may be treated without hesitation, and without much danger. If very large, it may be as well to draw off a portion of the fluid, in the first instance; and subsequently to have recourse to setons or to injections of iodine. But as in any operation in the region of the mouth and neck, œdema may occur about the root of the tongue and the fauces, and interfere with deglutition or respiration, it is better to select the less irritating and most simple treatment, before proceeding to the more heroic.

In the treatment of *mucous* cysts of the mouth, a seton, or injection of iodine, will often be found inefficient; the cyst may fill again in a short time. If a portion of the cyst be cut away, the contents allowed to escape, and nitric acid applied freely to the interior, the treatment will generally be found successful. Some of the small, isolated, mucous cysts, situated immediately under the mucous membrane, may be readily removed by the knife; but the attempt to remove a large and more deeply-seated cyst is hazardous and unnecessary. Sir W. Fergusson relates a case which illustrates the difficulties a surgeon may encounter in such a proceeding, and the danger the patient may undergo.[1]

We would strongly dissuade from the attempt to remove a large cyst in the region of the mouth; not only are there consid-

[1] Fergusson's Practical Surgery, p. 599.

erable obstacles to the entire removal of the cyst from its bed, but the operation must necessarily be a tedious one, and there would be risk of great loss of blood. By laying the cyst freely open, in all probability it will close up from the bottom, or, at any rate, become so much diminished, that ultimately a series of punctures or openings, a seton, or injection of iodine, will effect its obliteration. A silver wire may be used as a seton, if the cyst project more towards the integuments than the mouth, and the contents, by tapping, are proved to be clear and thin; but if opaque, dark-colored, thick, or purulent, a free incision is the safest, the most effectual, and the least tedious treatment to adopt.

A large cyst opened by incision in the mouth, and found to contain purulent fluid, may not contract very rapidly, in consequence of matter bagging downwards in the neck, in the lower part of the sac. Under such circumstances, a small opening may be made under the jaw. But as a scar in the neck, especially in women, is always objectionable, such an opening had better be avoided unless absolutely requisite.

By far the greater number of the different varieties of cystic formations (independent of bone) will be found on the inner surface of the lips, the surface of the gums, or on the floor of the mouth; and the treatment above described may be followed accordingly, care being taken to ascertain first the character of the fluid contained; for should the contents be blood, the treatment should be different to that described.

Sanguineous cysts about the mouth are rare. When present, they are usually seen on the lips, near their free border. Instead of free incision, when deeper seated they should be treated with setons or ligatures; when superficial and accessible, they may be dissected out, or included in a ligature, like a nævus.

To sum up the evidence on the history of mucous or serous cystic affections of the mouth, we find that, in early life, they occur either singly or in clusters; are generally of a congenital nature; and are found most commonly on the floor of the mouth, or, in after life, on the surface of the gums. Venous or sanguineous cysts are generally observed in the lips and on their inner surface; are usually congenital, and frequently stationary; in this they differ from other cysts. Sebaceous cysts, containing sometimes a mixture of epithelial, thick, white, and often putrid matter; hair growing from the lining membrane (which partakes of the character of cuticle); or loose hairs; bone or teeth—these have no peculiar affection for locality, are most capricious in their selection of spots for habitation, and may be found in any part of the mouth or its immediate neighborhood. They are usually round, small, and, if immediately under the mucous membrane, appear like a white marble embedded in the areolar tissue. Their inclination is to grow slowly; so slowly in some instances, that years may elapse before their presence occasions inconvenience. These may all be of the congenital variety. Mucous cysts, ranulæ, cysts of the lips connected with portions of solid or glandular growth, some serous cysts, and those generally single, will be found to commence after birth, and at different ages. They usually occur before very advanced life.

Solid growths of the lips and mouth, of a non-malignant, *i. e.*, non-cancerous character, are not of many kinds, nor do they frequently occur. Labial glandular tumors have already been referred to. Occasionally a fatty tumor grows among the muscles of the tongue, or about the floor of the mouth. The diagnosis is usually simple, though when deep-seated it may puzzle the surgeon, until he cuts down upon the growth. Its tendency is generally to protrude towards the skin, rather than towards the mouth; the constant movements of the tongue being usually sufficient to direct the mass towards the least resistant surface.

A fatty tumor need only be removed when of an inconvenient size. A free incision over its surface, below the jaw, will generally allow of its being readily dissected or dragged out.

The author removed one for a lady, forty years of age, who had been aware for some years of its existence, under the tongue and jaw, on the left side. On cutting freely down upon it, the lobes of fat were found to dip deeply into the floor of the mouth, round the mylo-hyoid muscle; but the whole was readily removed.

The chief danger attendant on such an operation is extension of inflammation and suppuration to the intermuscular tissue about the root of the neck. The lady alluded to, had for some days considerable pain and difficulty in swallowing, but ultimately recovered.

A solid mass is sometimes observed in the floor of the mouth, of a calcareous consistence. Such a mass is often contained in one of the salivary ducts; it is but a salivary calculus. Occasionally, from neglect or indifference, one has been known to acquire a size which would be usually considered an intolerable nuisance and a source of constant disturbance to the patient's comfort. It can be readily removed by a slight incision over it through the mucous membrane.

The condition, in infants, known as

"tongue-tie" has been spoken of in the essay on DISEASES OF THE TONGUE.

TUMORS OF THE JAWS, AND THE OPERATIONS FOR THEIR REMOVAL.

There are few points in Surgery which require more careful consideration, in order to arrive at a correct diagnosis, than the variety of tumors which affect the upper and lower maxillary bones. We propose to consider these tumors in the following order, viz:—

1. Cartilaginous.
2. Cystic.
3. Fibrous.
4. Myeloid.
5. Osseous.
6. Vascular.
7. Mucous, or Myxoma.
8. Cancerous.

The operations for the removal of tumors of the jaw will form the subject of subsequent consideration.

Cartilaginous tumors of the bones of the face are rare, and the upper and lower maxillæ may be said to be almost free from their attacks. [In 450 cases of diseases of the jaws, Heyfelder has found 8 cases of enchondroma.]

Mr. Paget alludes to but one well-known case, which occurred in the upper jaw of a patient in Guy's Hospital. Mr. Beaumont, Professor of Surgery in the University of Toronto, has recorded an interesting case in the Royal Med. and Chir. Transactions,[1] which occurred in a boy seven years of age, affected the lower jaw, and was successfully removed.

In the Museum of the College of Surgeons is a wonderful specimen of one of these tumors, which implicates the greater portion of the lower jaw; it had been some eight years growing, and when the patient died, exhausted by its ravages, it measured two feet in circumference.[2]

The symptoms and prognosis of enchondroma are the same, when it affects either of the jaw-bones, as in other parts of the body. [The diagnosis is necessarily uncertain, the only valuable points being the irregularly lobed appearance of the growth, and its density, which is intermediate between that of fibromata and that of osteomata. They occasionally develop after injury, are of slow growth, and are chiefly peculiar to young persons, though not at all limited to them.] These tumors of the jaws may be removed with much confidence of relief. The operation cannot be too early decided on; delay may be so far dangerous, that a very rapid growth, by a short postponement, may really make the operation very severe and extremely hazardous.

[1] Vol. xxxiii., p. 243.
[2] Museum Catalogue, No. 1034.

In the removal of the smallest cartilaginous tumor, care should be taken that every particle of the surface of the bone from which it is growing be freely removed. In the removal of the larger tumors, it will depend on the involvment of the bone, how much of it has to be removed. The greater portion of one side, or even the whole, of the lower jaw, or the whole of the upper maxillary bone, if involved, must necessarily be taken away. The disease will probably be restricted to one side in the upper jaw; in the lower, it may more readily involve the greater part of the bone. The prognosis after operation is usually favorable; but it should not be overlooked that enchondroma sometimes recurs, and that in other cases the tumor grows rapidly, and large cysts are developed in its substance. [Mr. Heath records a case in which an enchondroma of the superior maxilla returned four times after successive operations, the patient finally dying from erysipelas.] Both these forms of enchondroma approach in character to cancerous tumors. [When uninterfered with, these growths cause death by their encroachment upon the larynx and œsophagus.]

Cystic tumors of the jaws are not very uncommon.[1] We undertake their consideration in this place, in order to mark particularly the distinction which must always, pathologically, be made between the secondary cysts of bone resulting from degeneration of cartilaginous tumors, and the primary cystic tumors which attack the upper and lower maxillæ. The latter are seen to originate in the substance or from the surface of the jaw, under a variety of unexplained circumstances.

Cysts of the jaws are sometimes found to be connected with a diseased condition of a tooth-fang; or, more frequently, with a diseased action attendant on the development of the tooth-pulp—"dentigerous cysts." (See p. 571.)

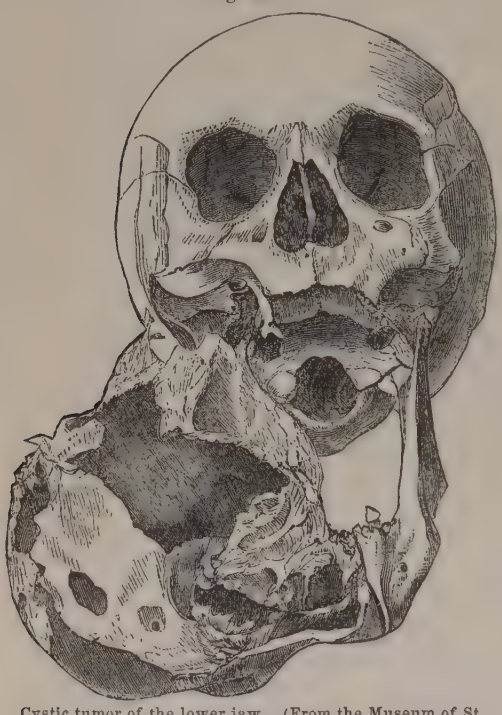
Specimens of simple primary cysts of the jaws, commencing in the substance of the bone, may be found in some of the museums of the metropolis. They expand the bone more or less, so as to take with them portions for their outer covering or walls, the remainder of which will be generally made up of a tough membranous substance. [The characteristic features of these cysts is said to be a thinning and expansion of the external wall of the maxilla so that it becomes pliant and crackling under pressure. Garretson has never found this symptom—the crackling sound—present.] The contents are fluid, serous, or gelatinous, and of different

[1] See Stanley, Diseases of the Bones, p. 268; also, DISEASES OF BONES, vol. iii.

shades of color. "This disease is usually of slow growth; and there have been instances in which the tumor of the jaw, formed by it, has acquired a large size."[1]

In the Museum of St. George's Hospital may be seen a preparation (fig. 362) which well illustrates the prominent features of a simple cystic tumor of the jaw. The tumor was removed from a woman forty-five years of age. It occupied on the right side the situation of the lower jaw, and extended from the second incisor to the condyle of the bone; it formed a large globular cyst, which occupied nearly the whole of the side of the face.

Fig. 362.



Cystic tumor of the lower jaw. (From the Museum of St. George's Hospital.)

It extended downwards over the upper portion of the neck; and inwards, displacing the tongue; it greatly interfered with speech and mastication. The principal part of the growth was upwards and outwards towards the malar bone, which was somewhat expanded and partly absorbed. In some parts the tumor appeared of bony hardness; in others very elastic. The integument covering it was not discolored, and there was no enlargement of the neighboring glands. The disease had been noticed about eighteen years before admission, when it formed a small, hard, incompressible lump, just over the angle of the jaw; it gave no pain; and for a long time its increase was extremely slow. About six months previous to her admission, it commenced to enlarge very rapidly. The cyst may be seen in the figure to extend from the symphysis to the right condyle.

The parietes are partly osseous and partly membranous. The entire substance of the jawbone on this side has disappeared, and is replaced by the foreign growth. When removed, the cyst appeared to be divided into several cells, which contained a transparent gelatinous fluid; though in the dried preparation there are but few indications of such divisions. The tumor was successfully removed; but the patient died subsequently from erysipelas.

In the Museum of the College of Surgeons there is a specimen of a cyst of the lower jaw, occupying the greater extent of the right side, and projecting outwards rather than upwards. It is oval in shape, and multilocular; the cells were filled with a glairy fluid. The diseased portion of the jaw was successfully removed.[1]

Whatever the origin of these cysts, they appear, on the one hand, independent of any tooth-irritation; and on the other, of any previous cartilaginous deposit. The diagnosis in such cases is not beset with much difficulty; and even if a doubt exist as to the nature of the tumor, it is at all times safe and easy to explore it with a fine trocar.[2]

In the treatment of these tumors, it is a milder and a more justifiable course to make a free incision into the cyst, and subsequently to trust to reparative action, than at once to have recourse to removal of the diseased mass. [The opening into the cyst must always be kept patulous; stimulating injections are thought to hasten the reparative action.]

If the cyst be large, or even if it be ultimately requisite to remove it in its entirety, the previous incision will in all probability have much reduced it in size; when the parts, if not in a better, will certainly be in no worse condition for removal.

In both the cases related removal of the tumors was accomplished without difficulty.

[1] Stanley, op. cit., p. 267.

[1] Museum Catalogue, No. 1033.

[2] M. Giraldès has described a form of cyst in connection with the upper jaw, which he believes to be of very common occurrence, and to be formed by a morbid change in mucous glands naturally existing in the lining membrane of the antrum of Highmore (see his Récherches sur les Kystes muqueux du Sinus maxillaire); but no such origin can be ascribed to those which distend the body of the lower jawbone in the manner above described.

Two cases are mentioned by Mr. Paget, in which incisions were employed successfully; but in neither case did the bone appear diseased.

In a case under the author's care in St. George's Hospital, the cyst occupied a large portion of the left side of the upper jaw. Its anterior wall projected under the cheek, and bulged out the side of the face. A free incision was made into the cyst from within the cheek. The anterior wall was found to be partly membranous, and partly consisted of thin flakes of bone. A portion was readily removed, so that a free opening was left for the escape of the contents, which were of a glutinous consistence and brownish in color. At the bottom of the cyst, there was found projecting into its cavity the extreme point of the fang of the canine tooth. On the removal of the tooth, the fang was found to be partially necrosed. The cyst filled and closed in a short time without any further treatment. The patient was about ten years of age, and when he quitted the hospital there was no trace of the disease left, nor the slightest disfigurement.

In all cystic diseases of the jaws, careful examination should be made of the teeth of the corresponding jaw; all diseased ones near the growth should be at once removed. One of the most frequent causes of serious mischief, and still oftener of exquisite suffering, is the too long abode of defective and decayed teeth in their sockets. We feel satisfied that the greater the experience in the treatment of diseases about the mouth, the more exacting will the surgeon become respecting the removal of all useless, defective, or decayed teeth or stumps.

Fibrous tumors of the upper and lower jaw are by no means uncommon; and in their general features, in their growth, and in their varieties, correspond to fibrous tumors of other parts. "The favorite seats of fibrous tumors of bone and periosteum are about the jaws."[1] Such tumors may originate in the substance of the bone, and in growing, expand it, as a crust, over the outer surface of the tumor. In the Museum of the College of Surgeons there is a preparation showing a fibrous tumor of the jaw, with a thin shell of bone over it.[2] They may grow from the periosteum, and embed the bone in their surrounding mass. They affect equally the upper and the lower maxilla. They may appear early in life.

Mr. Liston removed a large fibrous tumor of the upper jaw, in a woman twenty-one years of age, which had made its appearance four years previously.[3] It grew on the outer side of the jaw, and was removed six months after its first appearance, when about the size of the end of the thumb. In eighteen months, a return of the disease, the size of a hen's egg, was removed, with a portion of alveolus. The growth reappeared in two or three weeks, and attained a large size in two years, which rendered necessary the removal of the whole of the superior maxillary bone. The patient recovered.

Fibrous tumors of the jaws are usually of rather slow growth; but their growth may in exceptional cases be somewhat rapid. Their usual history is one of progressive and persistent increase; perhaps more rapid in proportion to their increase of size, but, in the main, rather slow than rapid. The size some will attain is best illustrated by the collections in our various museums; and especially the preparations collected by the late Mr. Liston, now in the possession of the College of Surgeons. In some respects, as to the size which they attain, they appear to vary from fibrous tumors of other parts, and especially those of the uterus: for fibrous tumors of the jaws are not usually seen to expend their energies in growth; they are not seen to stay their course, to degenerate, or calcify; or perhaps something may be said to depend on their position, for this is such that it can never permit of sufficient increase, or life, to attain that end, without first having grown to such a size as would occasion a fatal impediment to deglutition or respiration. They are usually painless in their growth, and innocent in character, as compared with cancer; but their locality, as they grow, renders them formidable as to disfigurement, as to discomfort, and even ultimately to life, if they be not removed before such growth be attained. It is wise, therefore, to pass the verdict of early removal, when we have to pronounce judgment on such cases; the earlier the operation is performed, the less formidable will it be. We cannot hold out a prospect of arrest; but we may certainly forewarn as to the inconvenience of delay, and we may positively predict danger from increase.

In their structure, we cannot point out any distinction between the fibrous tumors which attack the lower, and those found connected with the upper jaw; but, practically, there are some important considerations connected with the history of the latter, to which we would especially draw attention; and a knowledge of which is most essential to any operator dealing with such cases. Fibrous tumors of the lower jaw are invariably more or less globular in form; usually they have a uniformly smooth surface; their tendency is to protrude externally, more than towards the mouth: if originating in the substance of the bone, perhaps they may

[1] Paget, vol. ii., p. 145.
[2] No. 1045.
[3] Museum of College of Surgeons, No. 1046.

be found equally surrounding it; if originating in the periosteum, perhaps most prominent on the corresponding surface. Fibrous tumors of the upper jaw are often far different in their outward character, in their surrounding relations, and in the tendency they display, from position, to spread in different directions. A fibrous tumor supposed to be attached to the upper jaw, may really have its origin from the base of the skull, the sphenoid, or the ethmoid bone; and from either point make its way through the various foramina and fissures, and into the various fossæ in and around the superior maxilla. Instead of a globular dense mass, as in the lower, the tumor of the upper jaw may be lobulated; or, from its very position, and as a result of its insinuation into these fissures and fossæ, it may be moulded, as it were, into a mass of pedunculated bodies, somewhat analogous to the bulbous roots of a tuberous plant; or commencing in the interior of the antrum, it may by growth or position be pressed through its anterior wall, and puff out the cheek; or through its floor, and push down into the mouth; or into the nares, and plug up the lacrymal duct; or into the orbit, and displace the eyeball; or into all or several of these spaces, and produce corresponding deformity. So that the diagnosis of the origin of a fibrous tumor of the upper jaw is often as complicated an affair as that of the lower is easy; indeed in some cases, until the upper jaw be removed, it will be impossible to determine to which portion of the skull, or bones of the face, the growth may be attached.

[If the fibroma has had its original seat in the jaw, however, it shows little tendency to invade surrounding parts, but remains fixed, growing slowly, lobulated and with a broad base. In these cases the diagnosis is not so difficult.]

The following case illustrates the force of these observations. A man twenty-five years of age was admitted into St. George's Hospital, under the care of Mr. Prescott Hewett, "with a large tumor, of an irregular shape, occupying various regions of the left side of the face." In the cheek it formed a swelling of the size of a turkey's egg, and filled up the greater part of the superior maxillary region; the outline of the bone was perceptible to the touch in a few places only; the zygomatic arch was much more prominent and more curved than natural, having been pushed forward by the tumor, portions of which could be felt under the temporal muscle. The diseased structure was also found, in the shape of small flattened bodies, at the lower part of the orbit, lying immediately underneath the conjunctiva, and apparently quite movable; the bones of the inner and outer walls of this cavity, as well as those forming its circumference, were not affected or displaced; but it was impossible exactly to make out the state of the bones at the lower wall, owing to the tumors which were there; the eyeball was not more prominent than natural. Portions of the morbid growth were detected in the left nasal fossa, from whence a small round mass projected slightly, at times, into the pharynx. The tumor overlapped the front part of the alveolar process, and projected beneath the lip.

About six years previously, the patient had observed what was supposed to be a polypus of the nose, which was easily removed; but some little time after, the cheek began to swell, and gradually the tumor commenced to show itself in the various other positions described. Its growth was painless throughout. A year previous caustic had been freely applied, with the idea of destroying it; and two large cicatrices marked the places of its action. At various times there had been extensive bleeding from the nose; these bleedings had somewhat reduced the patient, who was of a spare habit and pale; this paleness being attributed to a loss of blood, which occurred shortly before his admission. It was decided to remove the tumor by the usual incisions for the removal of the upper jaw. The bones having been divided with cutting forceps, the superior maxillary and malar were easily tilted out of their place; when it was found that the disease was not connected with the upper jaw, but was behind it. The greater portion, which was in view, was removed; some portions were lying in contact with the pterygoid process; some portions embedded under the temporal muscle; other portions in the orbit. Before the operation could be completed the patient became so faint that it was found impossible to proceed with the operation, and he subsequently sank.[1]

The preparation of the parts shows the superior maxillary and malar bones, and portions of the tumors extracted from behind them; the bones are healthy, but altered in shape from pressure; the tumors present all the characteristics of fibrous structure. The parts removed after death show a morbid growth, originating in the root of the left nostril, and especially on the inner edge of the pterygoid process and under surface of the body of the sphenoid bone, to which parts small portions of tumor were found still attached. The sphenoidal sinuses were filled with diseased structure of a similar character, and were very much dilated; so much so that at one point the bone had altogether disappeared, and left a small hole, where the tumor was lying in contact with the dura mater. A small portion of the growth was also found at the upper and back part of the septum nasi, which was forced over to the right side and partially destroyed by absorption; here the mucous membrane was somewhat thickened; and there was a small pendulous body, loosely connected to the velum palati, and hanging by the side of the uvula. Small flattened growths of a similar nature,

[1] Med.-Chir. Trans., vol. xxxiv., p. 43.

and of a bulbous shape, were found deeply embedded in the spheno-maxillary and temporal fossæ, as well as at the back part of the orbit. None of them had any attachment to the bones; they were all connected to each other, and to the growths in the nostril by a slender pedicle, which passed in the direction of the spheno-palatine foramen; the growth in the orbit had reached that situation by creeping through the spheno-maxillary fissure. The bones of the orbit were quite healthy. The preparation is in the Museum of St. George's Hospital.

The removal of a fibrous tumor with the entire portion of the jaw with which the growth is connected, does not necessarily ensure an immunity from recurrence. [It is better, in view of the impossibility of diagnosing the simple from the recurrent fibromata, to remove the bone in its entirety, in the case of the upper jaw, leaving if possible the orbital plate. In the inferior maxilla, such a growth should be excised with an ample amount of sound bone on either side of it.] Two specimens in the Museum of the College of Surgeons illustrate the reproduction of a fibrous growth, subsequent to the removal of a previous one.

One preparation shows the right side of the lower jaw, from the angle to the first bicuspid tooth, with a tumor of a fibrous character, two inches in its greater diameter, and situated entirely on the anterior surface of the bone, and extending along nearly the whole portion removed. Its base is osseous, and the rest fibrous.[1] The other shows the ascending ramus, condyle, and coronoid process of the lower jaw, with a tumor of a similar character.[2] A woman thirty years old had suffered from "toothache" from nine years of age, after a blow on the cheek. The first portion of the jaw, with the tumor, was removed about five months after it was first observed; its growth had been painful, both in the jaw and the cheek, and was attended by constant headache. No portion of the disease was apparently left at the first operation. But the disease reappeared at the ramus, which was subsequently removed at the joint. The patient recovered.

Subject to this occasional tendency to recurrence, fibrous tumors may be classed as essentially innocent; largely so, in proportion to many of those which affect the jaws; if by the term innocent we intend to convey the possibility of complete eradication by operation, and, subsequent thereto, a total immunity of the part and the system from recurrence of the disease.

And yet, as in other parts, so in these, we must be prepared to meet with fibroid tumors which present many of the characteristics of true fibrous growths, but possess in addition the peculiar property, that upon each removal there appears a more rapid tendency towards recurrence, as well as greater rapidity in growth; from the true structure of fibrous tissue, as each removal takes place, there is a gradual shading off into fibro-plastic or mere gelatinous tissue; until at last rapid growth and rapid deterioration of constitution run hand in hand, and the patient sinks, exhausted by a foul ulcerating sore based on a monstrous fungoid mass. When cut into, this mass presents a smooth, gelatinous, and somewhat elastic surface; the structure abounding in serosity, and often readily broken down; void of many blood-vessels, and of a low vitality.

Fibrous tumors of the jaw may be partly composed of bone; or partake of a fibro-cellular character, such as we find in similar tumors of other parts of the body. In the Museum of St. George's Hospital is a preparation showing, on section, a small nucleus of bone which in no part approaches the surface of the tumor.[1] Another specimen shows much bone radiating into the substance of a fibrous tumor from its base, and approaching in some parts very near the surface.

Fibrous tumors, usually of slow and painless growth, are often attended by suffering when they affect the jaws; and their growth may be sufficiently rapid to require the aid of the surgeon within a few months of their outset, to obviate the serious results of pressure and encroachment on the cavity of the mouth.

"As a general rule," says Mr. Paget, "the vascularity of a fibrous tumor is in inverse proportion to its singleness and toughness of construction."[2] Yet, in the region of the mouth, we constantly observe a tendency to recurring hemorrhage; perhaps to be attributed in some measure to the friction the surfaces may be subject to, or the accidental bruising they may receive, in the daily process of mastication. This hemorrhage is not usually very great at any one time; but it has this important practical bearing, that by its amount or by its frequency it deprives the patient of much blood; he becomes blanched and reduced; and if relief be long deferred, he becomes little capable of undergoing an operation, which of itself often exacts the immediate loss of a large amount of blood. A case already related points to the principles here enunciated.

Myeloid tumors of the jaws.—What has already been said relative to the general features of fibrous tumors originating in the jaws will to some extent apply to

[1] No. 1041, College Museum.
[2] No. 1042, ibid.

[1] Series ii., No. 155.
[2] Op. cit., vol. ii., p. 134.

myeloid tumors affecting these bones. They will perhaps be found to affect those parts almost as frequently as the fibrous tumors. The Museum of St. George's Hospital contains several specimens of myeloid growths, connected with the maxillary bones.

The general characteristics of these growths have been well summed up by Mr. Paget. "Myeloid tumors," he says, "usually occur singly; they are most frequent in youth, and very rare after middle age; they generally grow slowly and without pain; and generally commence without any known cause, such as injury or hereditary disposition. They rarely, except in portions, become osseous; they have no proneness to ulcerate or protrude; they seem to bear even considerable injury without becoming exuberant; they may (but very rarely) shrink, or cease to grow."[1]

A specimen in the Museum of St. George's Hospital shows a tumor about the size of a nut, with a portion of the whole depth of the lower jaw, which was removed from a girl eight years of age. Four and a half years after, she remained well.[2] Mr. Cæsar Hawkins removed a tumor of a similar nature, with a portion of the alveolus of the upper jaw, from a little girl five years of age, in St. George's Hospital. This had grown rapidly in the course of about three weeks, and was successfully removed.

The diagnosis of a myeloid tumor is always uncertain without microscopical examination of its structure. The general disposition has already been fully described by Mr. Paget. In its origin and growth, in connection with the jaws, it may be mistaken, as in all other parts which it attacks, for cartilaginous or fibro-cellular growths. Its characteristic features are most marked in its intimate structure; for an account of which we refer the reader to the essay on TUMORS, Vol. I. p. 264.

The nature of myeloid tumors of the jaw permits of no half measures in treatment; entire removal of the growth, with the portion of bone to which it may be attached, is the only safe, the only justifiable course to be pursued; and no delay should be recommended or sanctioned. As it will surely grow large when once started, it should without hesitation be removed whenever detected. The removal does not always ensure safety. There is no doubt that myeloid disease is sometimes recurrent. The experience of late years has fully established this fact.

Osseous tumors of the upper and lower maxillæ are not very commonly met with, but occur sufficiently often to make them especially interesting, in connection with the surgery of the mouth. They will be found to occur in two different forms or characters: simply as outgrowths from the parent bone, to which a base more or less narrow or broad is attached; or as a general thickening and enlargement of a part, or of the entire bone, terminating often in considerable and even frightful malformation.

The true osseous tumor is often compact, heavy, hard, and ivory-like on section; or else more spongy or cancellous, much less hard, and much less weighty in proportion to its size. Practically, the size, the rapidity of growth, and the locality, are of more importance than the exact condition of its structure.

Osseous tumors are seldom rapid in growth; they may affect any portion of the jaws; they are not usually painful, but generally and steadily increase in size, and sooner or later their removal is rendered imperative.

In the Museum of the College of Surgeons is a preparation which shows the true character of the hard ivory-like tumor of the jaws. It is seen growing from the angle of the lower jaw, to which it has an attachment by a broadish base.[1] Another similar specimen may be seen in the Museum of St. George's Hospital.[2] The removal of these outgrowths, whether they implicate the upper or lower jaw, presents no greater difficulties than does the removal of fibrous or other tumors; excepting, that if deeply nodulated and irregular on the surface, they may be entangled in the fibres of the adjacent muscles, and require much careful, it may be tedious dissection, before they can be cleared from the surrounding soft parts.

There remains to be considered the other condition referred to, in which the bones of the face, or any portion of them, take on a peculiar process of growth, thickening, and occasionally great enlargement.

The Museum of the College of Surgeons contains specimens illustrative of this diseased action in bone, and they demonstrate what an amount of hideous deformity may occur in the victims of this horrible disease—horrible, inasmuch as it appears perfectly beyond the control of medical treatment; and unless seated in a part readily removable, entails on the wretched sufferer a lingering malady which, though slowly, yet surely, in most cases, continues its growth until its mechanical interference with the process of deglutition, or some other complication, causes death.

The tendency of this disease appears to

[1] Op. cit., vol. ii., p. 217.
[2] Series ii., No. 168.

[1] No. 1035. [2] Series ii., No. 191.

be, that it does not restrict itself to one bone, or one portion of a bone; but that several bones contiguous to each other may become affected in their turn, and to such an extent that all surgical interference would be quite out of the question. If, however, the disease be confined to one portion of the face, such as the lower jaw or the antrum, it may probably be relieved by operation.

This diseased action may be set up in very early life. A case is related by Mr. Paget, in which Mr. Stanley removed the superior maxillary bone in a girl, fifteen years of age, in whom the swelling had been observed to commence eight years previously.

With respect to treatment of osseous tumors generally, it will be found, as a rule, that neither local applications nor constitutional measures appear to arrest, or destroy their growth. It is but a waste of time, and trifling with the patient's confidence, to suggest anything but the entire removal of the tumor. Of course this recommendation will depend on the amount of bone implicated by the disease; but if the mass can be *entirely removed* by the knife and saw, and the operation be otherwise practicable, the removal of the tumor is most likely to be perfectly satisfactory in its results. "It may be stated," says Mr. Stanley, "that absolute security against the production of an exostosis, can be obtained only by the removal of every part of its circumference. If but the smallest portion of the exterior of the exostosis, with its cartilaginous capsule, be left, reproduction of the tumor will be, at the least, not an improbable occurrence."[1]

Experience has fully confirmed the observations just quoted; and the caution which they inculcate is, not to attempt the removal of a portion, when the whole mass of an osseous tumor may present obstacles to its entire resection. How far the hypertrophied condition of bone may hereafter prove to be subject to constitutional treatment, is a fair question of experiment. The disease is not common, and opportunities are few in which the efficiency or benefit of drugs, externally or internally, can be fairly tested. The disease has certainly something more of a constitutional character than simple osseous outgrowth, and the condition is one which has been known occasionally to assert the prerogative of hereditary transmission. In reference to treatment, Mr. Stanley states, that "medicines have no influence upon the disease."

In their removal by operation, there is an exception to the rule which applies to osseous tumors, that the whole of the disease must be removed; for when the deformity is the result of hypertrophy, if the whole mass is beyond removal by the surgeon, even a portion may be cut away with present, if not permanent, benefit. "I know, in cases where only part of the hypertrophied bones have been removed, the wound has healed soundly over the remaining portion of them, and it has not in such instances appeared that the operation was followed by any increase of the disease."[1]

[*Atrophy of the maxillæ.*—M. Vallin records several cases in which, during the course of locomotor ataxy, an osseous atrophy of the alveolar borders of the maxillæ occurred, so that the teeth dropped spontaneously out of their sockets. His observations have since been confirmed by others.]

Vascular tumors of bone are so rare, and of the jaw so few instances have been put on record, that we even venture to express some hesitation in taking for granted that those described may not have been tumors of a cancerous nature. The entire removal of the disease is the only treatment to be recommended. As described, the disease appears to commence in early life, and to be painless; but its external characters are such that no very accurate opinion can be formed of its nature, unless it present on the surface the deep-red color produced by enlarged vessels.

Mucous tumor, or myxoma.—Virchow has drawn attention to this variety, and Mr. Moore fully described its characteristics in his article on TUMORS (Vol. I., page 255). They are rare in the jaw, but have been met with. They may be removed like other tumors, and are not liable to return.

Cancerous tumors of the maxillæ, and cancerous ulcerations of the gums, remain to be considered.

Cancer of the bones of the mouth is by no means uncommon; it is generally of the medullary form, occasionally of the osteoid variety. Cancer of the gums is more rigidly confined to the epithelial character. Scirrhus, in its onslaughts, appears to disregard these regions; for though found as a secondary condition in bone, it has not fallen to our lot to notice it in the bones of the face; the experience of others confirms this observation.

Cancerous growths are observed more frequently to affect the superior than the inferior maxilla, and to commence most frequently in, or around, the walls of the

[1] Stanley, On Diseases of Bones, p. 157.

[1] Stanley, on Diseases of Bones, p. 5.

antrum. The history during life, and the anatomy, of medullary and osteoid cancers of bone, written elsewhere in this work, apply in every minute particular to the origin, the growth, and the structure of cancers affecting the bones of the face. It is not, therefore, requisite to enter now into a minute examination of their constituents; our remarks will embrace the chief practical features to which the attention of the surgeon should be directed, so that a correct diagnosis be arrived at, and prompt measures adopted where necessary.

Age is no criterion, in the diagnosis to be formed, respecting a cancerous tumor of the mouth. We observe the disease in children, in persons of middle life, in the extreme of old age. It commences often without pain, but it rarely progresses without suffering; and in many instances the pain of cancer affecting these bones is one of unmitigated torture. The external appearances of these tumors differ in many ways, and much in each case.

When the disease is confined to the lower jaw, its character may be more readily and earlier detected than in the upper. If medullary, it displays a softish pulpy mass, more or less elastic; projecting, it may be, on the outer side, and bulging out the chin or cheek; or on the inner side, and pushing down towards the throat; or it may uniformly surround the bone.

A case illustrative of the latter condition was (1863) in St. George's Hospital, under our care. It was rapidly running its course. The patient, a man aged forty-six, observed a swelling on the outer side of the lower jaw four months previous to admission. The tumor rapidly increased, and, on admission, involved the bone, from the symphysis to the first molars on each side. It projected backwards and downwards to the hyoid bone. The skin over it was stretched, and partially adherent, especially at the lower and left side, where it was thin, soft, red, and pulpy; much as if the disease had nearly made its way to the surface. Some of the teeth on the left side were becoming prominent and loose. Under such conditions it was thought best not to interfere by operation. The patient died about three months after his admission.

Occasionally the masses which project into the mouth run early into ulceration, discharge very offensive matter, and often have a ready tendency to bleed. If teeth become loose and are removed, a fungoid growth shortly fills the vacant alveolar sockets. The external parts, if the tumor project in their direction, appear soon to become thoroughly implicated in the growing mass; the skin becomes bound down to the parts beneath; it becomes darker colored, dusky-red, or purplish; brawny, uneven, and puckered, with soft round knobs projecting outwards; and ultimately ulcerated, when rapid destruction of structure sometimes occurs from sloughing. A foul excavated and irregular sore is thus produced. The neighboring lymphatics frequently bear evidence of the constitutional contamination; and the cachexia of cancer is usually well marked.

When the upper jaw is the seat of cancerous growth, there is often, in its early stage, some difficulty in arriving at a correct diagnosis as to the nature of the tumor. It is often but little exposed to view; it may be entirely embedded in an osseous chamber; or compressed and moulded by osseous walls, which, in the commencement, retard or direct the course of its growth. It may project into the nostril, block it up, and, perforating the septum, pass through to the opposite side; it may commence in the anterior wall of the antrum, and project forwards under cover of the cheek; or from the outer wall, and proceed downwards over the alveolus, and upwards into the temporal fossa; or from the interior of the antrum, and make its way uniformly into the nares, into the mouth, into the orbit, outwards, and forwards, and backwards. As it grows, the bones adjacent to it become expanded to some extent; then implicated or absorbed. If it presses forwards, the cheek and upper lip become distended and puffy; the fungoid growth within increases, and protrudes, sometimes, at the angle of the mouth; the eyelids become œdematous, and by degrees are closed; or perhaps, prior to this, the eyeball is

[Fig. 363.

Cancer of the upper jaw.]

pushed forwards or outwards; and the cornea, no longer covered by the lids, ulcerates or sloughs, and the contents of the globe escape. Nothing can be more hideous than the advanced condition of a medullary cancer of the upper jaw, presenting often a mass half as large as the head itself; ulcerated or sloughy on its surface; discharging horribly stinking pus, mixed with blood; and persecuting the sufferer with unabating and often agonizing pain.

Rapidity of growth is a strong point in the chain of evidence which is to decide the character of such tumors. But we have already observed, that rapid growth is seen occasionally in tumors of a non-malignant character. In medullary tumors, rapid growth is the rule; early attainment of size a marked feature; and the rapidity of growth commensurate with increase of size. The constitutional deterioration also is continuous. The early contamination of the skin with the tumor should surely point out to the surgeon the extreme foolhardiness of attempting to remove a mass of disease, the extent of which it is almost impossible to define; and, consequently, the satisfactory removal of which is rarely practicable, with due regard to the patient's benefit.

To illustrate the various points herein put forward, and to mark especially the difficulty of obtaining a satisfactory insight into the origin of such growths, as well as to indicate the utter hopelessness of attempting to remove many of them by operative interference, we wish to draw particular attention to the following cases: We were consulted by the parents of a child, L. C., aged five, suffering from a tumor, supposed to be connected with the upper maxilla of the left side. The left nostril was filled up and pushed outwards; the soft palate was much pressed downwards, and a portion of the tumor could be seen at its lower edge. Some attempts had previously been made to drag away the mass, but upon each occasion alarming hemorrhage occurred. As the disease was evidently medullary cancer, increasing rapidly, and there was great uncertainty as to its origin, it was recommended that no operation should be permitted. The child died within two months of our first visit.

The face was greatly disfigured, by considerable protrusion of the left eyeball outwards and forwards, by the expansion of the nostrils, and by the projection of a fungoid mass from the left one.

The dura mater, between the sella turcica and the ethmoid bone, was thickened on its attached surface, and readily separated from the bone. The corresponding portion of bone, as well as the cribriform plate and crista, were more vascular, darker colored, and less compact in structure than natural. The nostrils were filled with a whitish medullary tumor. It had projected in front to such an extent that it had separated the nasal bones and cartilages some distance from each other. Inferiorly, it had partially protruded through the anterior orifice of the left nostril, and had separated the palate processes of the superior maxillæ and palate-bones sufficiently to admit the point of a finger between their edges. The septum nasi was absorbed to a great extent; also the inner walls of the orbits; and thus the tumor projected into the cavity of each orbit, occupying the whole of that of the left side, where it had pushed the eyeball outwards on a level with the anterior orbital margin. The tumor had also penetrated into each antrum. Posteriorly it had passed through the openings of the posterior nares; was in close contact with the under surface of the basilar process, and the anterior surface of the upper cervical vertebræ; pressed down the soft palate considerably; and had extended into the pharynx almost as low as the epiglottis.

The above case illustrates the progress of medullary cancer of the upper jaw in childhood; the following shows how similar are the conditions in more advanced life; and both show how in each the surgeon would be foiled in any attempt to remove them. A woman, aged fifty, was admitted into St. George's Hospital in July, 1861, under the author's care, for a tumor apparently growing from the antrum, and involving its anterior wall and the hard palate. Five months previously she had a decayed tooth removed from the upper jaw, for pain on the left side of the face and head, immediately after which the gum enlarged, and an abscess which formed was opened, when the escape of about half an ounce of pus took place. The opening closed: but as the swelling returned, it was again lanced two days after, but on this occasion no pus escaped. From that time the swelling continued to increase, and now presented a prominent mass over the antrum and in the mouth, both in front of the alveolus and through the hard palate. The tumor grew very considerably. She suffered excessive pain. The eye, pushed forwards, became opaque, and sight was soon completely destroyed; deglutition also was difficult. She died about ten months from the commencement of the disease.

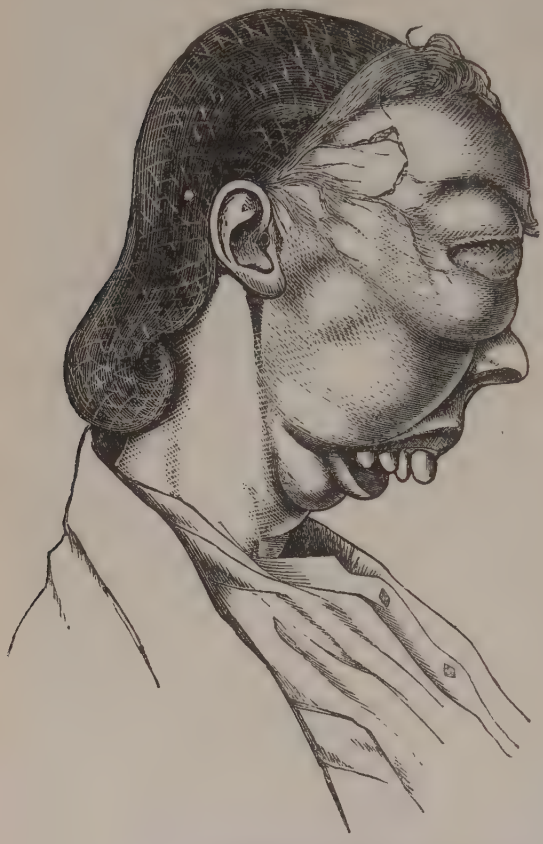
The skin was not implicated in the growth. The bones surrounding the mass were so soft that they were readily cut with a scalpel. The tumor projected largely into the mouth; it involved the palate, the inferior turbinated, the ethmoid, the sphenoid, and the superior maxillary bones. Through a portion of the ethmoid and sphenoid bones there was an opening communicating with the cavity of the skull. The growth, with the portion of upper jaw that remained connected with it, is in the Museum of St. George's Hospital.[1]

H. W., aged thirty-eight, was admitted to St. George's Hospital, under the author's

[1] The author is indebted to Mr. Charles Hunter for the post-mortem examination.

care, Jan., 1870. In July, 1869, she first noticed swelling of the right lower eyelid, with neuralgic pains over the right temple and brow. After a month the eye began to protrude. In September, the right cheek began to bulge out, and the right side of the nose to enlarge. The sight of the right eye had been failing for some two months prior to her admission. The mass now (April, 1870) projects into the right nostril, into the right orbit, and outwards under the cheek and masseter, and bulges into the mouth to a slight extent. Hemorrhage occasionally occurs from the nostril. The increase of the tumor is very perceptible; its aspect is represented by the engraving.

Fig. 364.



Portrait of a patient with malignant tumor of the upper jaw, and deficiency of the lower jaw.

The peculiarity of this patient's condition is, that *she has no vestige of a lower jaw.* It is related by her friends that when two years of age the lower jaw exfoliated entirely; but there is now no indication of such a bone having ever existed. She has always been fed on soft food.[1]

[1] The patient died soon afterwards.

If a cancerous tumor of the lower jaw be seen in an early condition, if it is situated near the symphysis, and the patient desire it, its removal, with the whole depth of the bone to which it is attached, may be attempted; for if situated in front, the limits may be ascertained, and the tumor dissected out entire. But if it involve the bone near the angle, we can seldom ascertain how deeply it may extend, or to what degree it involves, by infiltration, the tissues at the root of the tongue; it may extend far beyond the reach of the scalpel.

After all, it will be found that much discrimination is required on the part of the surgeon who has to decide upon the removal of a cancerous growth of the jaws: and so much depends on the individual features of each case, that it would be entirely out of the question to attempt a strict code of directions relative to treatment. At best, however, interference by operation is in the large number of cases most unsatisfactory: in the few, we hope some benefit is conferred.

[Dr. Ohlemann, of Bremen, tabulates (Archiv. für Klin. Chirurg., xviii., 2, 1875) the statistics of thirty-two cases of tumors of the upper jaw where complete or partial resection was done. The entire jaw was removed fifteen times, and part of it twice, for carcinoma. Out of twenty total resections there were three deaths and seventeen recoveries, while of twelve partial resections there was no death. Fifteen per cent., therefore, was the total mortality. He finds that carcinoma is much more frequent in middle and advanced life and is twice as frequent among men as women.

The ultimate result of the cases of carcinoma was fatal after an interval of from one to three years, the disease recurring in the cicatrix. Still, he considers that the operation should be undertaken in these cases, provided the disease be not so far advanced as to make it impossible to separate the diseased from healthy tissues, because it prolongs life and alleviates suffering. Agnew gives 128 recoveries in 158 excisions of all kinds of the upper jaw. He declares secondary operations to be useless.]

We cannot do greater justice to the subject than by transcribing, in conclusion, the words

of Monsieur Giraldès: "Dans le traitement des tumeurs du sinus maxillaire, il est des cas dans lesquels le chirurgien doit agir, et d'autres cas dans lesquels il est prudent de s'abstenir. Lorsque les tumeurs sont de petit volume, et surtout lorsque la constitution du malade n'est pas altérée, l'art doit intervenir, et dans ce cas, il peut arrêter le mal pendant quelque temps, et prolonger la vie des malades. Si la tumeur est volumineuse, sans que la constitution du malade soit encore altérée; si la cachexie cancereuse n'est pas développée, le chirurgien doit encore intervenir, et par deux raisons: d'abord, parce qu'il peut arrêter pour quelque temps la marche d'une maladie qui a une grande tendance à progresser; ensuite, parce qu'il peut avoir affaire à une tumeur fibro-plastique dont la malignité, dans le cas où elle serait maligne, serait tojours moindre que celle des tumeurs encephaloïdes. Lorsqu'enfin la tumeur du sinus est volumineuse, qu'elle envoie des prolongements en tout sens, que la constitution du malade est altérée, l'intervention de l'art ne ferait que compliquer un état déjà trop grave."[1]

The gums and the other soft tissues of the mouth, if affected by cancer, are usually attacked by the epithelial variety. Commencing gradually on the surface of the gums, it runs its course, similar to that species of cancer elsewhere. By degrees the ulcerated surface spreads; the

[Fig. 365.

Cancer of the mouth.]

borders of the ulcer present their usual thickened and elevated edges; not only the cheek, but the floor of the mouth and the tongue become secondarily affected. The disease in this situation is generally very painful; much distress is occasioned by movements of the cheek or tongue; much misery entailed by constant escape of saliva; great inconvenience and often difficulty is experienced in articulation and mastication.

[1] Des Maladies du Sinus maxillaire, p. 54.

No operation in such cases is justifiable. Epithelial cancer affecting the mouth appears to partake of a more malignant aspect than it assumes elsewhere; or rather, we might say, its local position renders it an obstacle to the requisite supply of food: consequently the life of the patient is sooner terminated. The treatment to be adopted is palliative: locally the use of gargles, to obviate the distress occasioned by offensive discharges; constitutionally, anodynes to lull the pangs which constantly dart through the parts affected.

Operations.

As operations for the removal of the lower or upper jaw, or any portions of them, have been fully described in all treatises on Operative Surgery, we feel that there is nothing new to record in the following observations. Our notice of the diseases of the jaws would, however, be incomplete, were we not to lay before the reader the general rules he should observe, and the manner in which he should proceed, when called upon to operate on either of these bones.

[The position usually recommended for the patient in these operations is the sitting or semi-recumbent posture. Roser, followed by Burow, of Königsberg, has performed numerous operations on the jaws and mouth, with the patient lying on his back, with so much of his body projecting over the end of the operating table that the head hung down with the crown vertical. It was fixed in that position by an assistant. In this manner he claims to do away with the necessity for tracheotomy, and to avoid all danger of suffocation by hemorrhage, the blood escaping chiefly by the nostrils. He has kept patients, 60 to 70 years of age, in this position from two to three hours, without unfavorable symptoms.]

Operations in diseases of the lower jaw may involve the removal of but a small portion of the bone; of a large portion of its anterior division; of one half—from the symphysis to the condyle; or rarely of the whole bone, with both articular processes. There is considerable difference in the method of proceeding under these various conditions; but chiefly as regards the external incisions required in each.

A small tumor may occupy only a portion of the anterior part of the lower jaw, and the growth be found connected with the alveolar edge without affecting the bone to a greater depth; extending perhaps further laterally than downwards. It may have involved the alveolar process to such an extent, that the corres-

ponding teeth are loose or have been pushed out. A case in which a tumor (fibrous) affected the lower jaw to the extent of the four incisors, came under our care a few years ago. The tumor was firm and painless, and involved about half the depth of the jaw. The canine teeth were removed; a saw was then used to cut down on each side of the tumor, through half the depth of the bone; then with a pair of cutting forceps, the upper half of the bone, between the lateral cuts, was taken away with the tumor still adherent to it. Sir W. Fergusson relates a case in which he removed a much larger portion, in breadth, of the lower jaw, by a similar operation.[1] He justly observes, that the advantages of being able to leave the lower half of the bone are very considerable; for the lower jaw retains its shape, and false teeth can be readily adapted to it when the parts are healed. When, under these circumstances, the tumor is small, no external incision is requisite. In the case alluded to, Sir W. Fergusson was obliged to expose the tumor, by making incisions from the angles of the mouth to the base of the lower jaw. If the operator can possibly avoid cutting through the lip, he should by all means do so: and it will be found that, by drawing the lower lip down, separating it from the bone, and with retractors pulling upon the angles of the mouth, a considerable surface of the anterior part of the bone may be exposed, without any external incision. Instead of two incisions through the lower lip, when a tumor has to be removed with the anterior portion of the jaw, one incision in the median line may suffice: it can be carried down below the chin without any obstacle or objection: and this allows the flaps to be drawn well over to either side, so as to expose a considerable portion of the bone. The downward extension of the incision also affords a ready escape for the future discharge from the wound.

When a tumor involves the whole depth of the bone, and this has to be removed with the morbid growth, the external incisions having been made, the flaps must be cleanly dissected from the tumor, to expose a sufficient surface of healthy bone on each side. In order to enable the surgeon to cut where the tissues are sound, the teeth should be removed where the bone is to be divided. The anterior surface being denuded, the posterior has to be freed from attachments of muscles, etc. Prior to passing the knife behind the bone, the tongue must be secured; a strong ligature should be passed through its apex, and held by an assistant. Of course this is only requisite when the muscles are detached at the symphysis. If this precaution be neglected, the tongue is apt to fall back, on the division of its muscles, and the patient runs the risk of suffocation. The ligature may be removed a few hours after the operation; in the mean time it should be held by an assistant, or otherwise secured on the face. A large fibrous tumour of the lower jaw was removed in our presence, with more than half of the bone, without any attention being paid to the tongue; the patient appeared choking, when the tongue was seized with a pair of forceps, drawn forwards, and immediately secured with a needle and thread, and the patient again breathed with comfort. If the tumor be very large, and irregular on its posterior aspect, it is better first to cut through the jaw at its sides, and then subsequently detach it and the tumor from its posterior adhesions. The isolated portion of the jaw can then be turned forwards, and the mass dissected from the soft tissues at the floor of the mouth, commencing within from above downwards. The method of dividing the jaw is simple, if properly performed. The outer shell of the bone should be notched with a fine saw, and then the bone cut through with a pair of strong bone-cutting forceps. When a tumor implicates the side of the lower jaw, or runs near to or involves the ramus, the external incision, to expose the bone, will differ from that described. If it be requisite to disarticulate the bone, the external incision should commence just above and over the corresponding temporo-maxillary joint; be carried down to near the angle [this cut is made over the ramus so as to avoid the parotid gland where it overlaps the masseter muscle, and also the parotid duct]; then turned forwards to the side of the chin and (if the tumor extend far forwards) towards the border of the lip, and terminate within a little of its free margin. The integuments on the side of the face included in this line of incision are now to be dissected upwards. The incision has crossed the facial artery; and as the flap is dissected off, the artery must be divided; it had better at once be tied, to save loss of blood. The bone immediately in front of the diseased mass has then to be divided, as described. The portion to be disarticulated must then be seized and drawn outwards; some force may be requisite to effect this. As the bone is drawn outwards, the mucous membrane and muscles are to be detached from its inner surface. The knife has only to be kept in close contact with the bone to effect this, and to avoid all unnecessary danger. As the articulation is approached, the bone should be still pushed forcibly outwards; the point of

[1] Fergusson's Practical Surgery, p. 668.

the knife made to cut close to it, and care taken, in cutting through the ligaments of the articulation, not to let the point be carried inwards, or out of sight. The external carotid or the internal maxillary may readily be wounded, if this precaution be neglected. If disarticulation be not requisite, in consequence of the tumor not extending to the condyle, the external incision need not be carried quite so high on the side of the face; but, in other respects, should be made in the direction just described. The bone, however, will have to be divided behind, as well as in front of the tumor. The remaining stages of the operation are comprised in securing all bleeding vessels, and in bringing the edges of the wound together. Silver sutures are probably most useful here. They should be introduced at frequent intervals, so that the corresponding portions of the side of the face be accurately adjusted to each other. The extreme vascularity of the tissues generally secures rapid union, and a speedy recovery from such an apparently frightful wound. The inner surface of the cheek should be supported with a fold of wet lint. The dissevered muscles soon adapt themselves to their novel duty, and within twenty-four hours are capable of supporting the tongue sufficiently to enable it to perform its usual offices, without fear of its retraction towards the pharynx. The chief inconvenience as regards the portion of the jaw which is left is, that it is apt to be drawn inwards. But if a thin cap of metal be adapted previous to the operation, so that the upper and lower teeth can be secured by it, it may be applied, as soon as the operation is completed, with great advantage. It steadies the parts, and does not interfere with the administration of food. This latter should be fluid, and may easily be sucked in between the lips, without separating the teeth on the sound side. The jaw should be supported by a handkerchief or bandage passed under the chin, and fixed over the head. Formidable as this operation is, patients usually convalesce satisfactorily; nor is the disfigurement, subsequent to the removal of a large portion of the lower jaw, or even the whole bone, so great as might be expected. In men the cicatrix can be partially hidden by whisker and beard; and in women a little artificial ornament will readily conceal the greater part. The material deposited in the situation of the original bone assumes a shape much like that of the jaw itself; becomes firm and fibrous, and able to support a plate with artificial teeth.

If the whole of the lower jaw is to be removed, the incision should extend from one side of the face to the other. Starting from over the articulation, the incision, on arriving at the chin, instead of being carried up towards the lip, should be carried onwards to the opposite angle of the jaw, and then upwards to the condyle. This is a formidable operation. If practicable, considerable facility may be obtained by dividing the symphysis immediately after the exposure of the surface of the whole bone. This step will be found to accelerate, and render much less complicated, the separation of the muscles and soft tissues from the inner surface of the bone and tumor, and especially to aid in the more rapid disarticulation of each condyle.

The extensive incision necessary for the removal of a large portion of the lower jaw unavoidably passes across and divides the larger branches of the portio dura; the result of which is loss of power over the cheek, and a drawing over of the mouth to the opposite side. This disfigurement, at first, is generally considerable, but appears usually to improve by time, though it rarely entirely disappears. Mr. Syme succeeded in removing a tumor confined to the ramus of the jaw by a modified incision on the side of the face, commencing over the tumor, and continued down towards the angle, and then forwards, without cutting into the mouth. The ramus, with the condyle, was successfully removed.[1] During operations for removal of tumors connected with the lower jaw, the patient should sit up rather than lie down. The blood thus escapes externally, more readily than into the throat. Chloroform [or ether] may be given with safety, but requires to be administered cautiously, with sponge or towel held near the nostrils. We should not do justice to British Surgery did we omit to mention that Mr. Anthony White, Surgeon to the Westminster Hospital, was the first to remove a portion of the lower jaw. In 1804, it appears, he set the example, and thus established the practicability of the operation.[2]

The operations requisite on the upper jaw vary according to the nature of the disease affecting it, and the extent to which the walls of the antrum are implicated thereby.

Small tumors growing from and involving the alveolar processes may be usually removed without external incision, as described in the lower jaw. Cysts of the antrum or gums may be attacked with trocar or knife, by first pushing up the lip, or drawing upon the angle of the mouth. But when it becomes necessary to remove a portion of the superior maxilla, the direction and extent of the exter-

[1] Syme's Contributions to Pathology and Surgery, p. 21, 1848.

[2] Medical Gazette, 1846, vol. ii., p. 529.

nal incisions are very important. When the tumor is small, and it is supposed to be limited to the inner surface of the antrum, or projects from thence into the nostril, an incision through the middle of the upper lip into the corresponding nostril, continued upwards from the attachment of the ala for an inch or more along the side of the nose, will enable the surgeon to dissect off a considerable flap, and uncover a very large portion of the superior maxillary bone.

When it is supposed requisite to remove the whole of the superior maxilla with a large tumor, a second incision to that described will be requisite. This second incision must be carried through the cheek, from the inner surface of the angle of the mouth, obliquely to the prominence of the malar bone; or if the tumor be very considerable, and implicates the malar bone, the incision can be run outwards over the zygoma; an ample flap may thus be secured, when the soft parts are dissected upwards from the anterior surface of the bones.

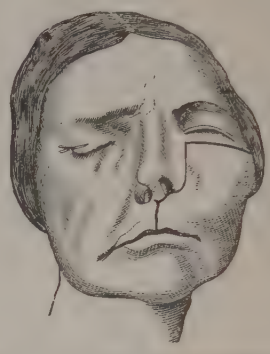
If, when the requisite incision is made, and the bone sufficiently exposed, it should appear that the disease is confined to the inner wall of the antrum, or growing from it into the nostril, the nasal bone should be cut through, and turned partially to one side, without entirely separating it from its periosteal attachments. Thus the nostril will be laid fully open, and the tumor can perhaps be removed without cutting away more bone. If this measure be successful, the nasal bone may be replaced, the flap of skin brought over it, and secured with sutures.

If the disease is found to affect the lower half of the antrum, and the orbital plate is free, then the latter may be left, and the former removed. The incisor teeth of the side affected having been extracted, the alveolus in front should be partially divided with a small fine saw; the surgeon cutting from the nares downwards. The cutting-forceps should complete the division of the bone backwards, with that of the hard palate. A line of incision had better first be made along the mucous membrane of the latter, on the side of the median line which is affected by the disease. Then the bone immediately below the margin of the orbit, and from the nostril to the outer edge of the malar bone, must be cut through with saw and bone-forceps, and the attachments of the soft palate separated with the scalpel. The portion of bone to be removed should then be seized with strong forceps, when, by means of a few additional cuts with the knife, the surgeon will be able to dislodge the lower portion of the maxillary bone, with the tumor attached.

If it be requisite to remove the whole of the superior maxilla, the external incision which extends in the direction of the zygoma must be continued backwards sufficiently to allow of the free exposure of the zygomatic process of the malar bone.

[This will make the incision correspond closely to that known as Fergusson's, which is described as consisting of two—one extending from the inner angle of the eye to the outer limit of the orbit, and parallel with and a little below the infra-orbital ridge, and the other commencing at the nasal extremity of the first, and carried down along the side of the nose, around its ala to the columnæ nasi, and from thence down to the middle of the upper lip.]

Fig. 366.



Fergusson's incision for removal of the upper jaw.

When the flap of the cheek has been freely dissected outwards to the margin of the orbit, the floor of the orbit must be cleared carefully of the attachment of the inferior oblique muscle, etc. The zygomatic process of the malar must be notched with the saw; the alveolar ridge similarly treated; and then the bone-cutting forceps employed. One blade of the instrument should be introduced into the nostril, the other at the inner and inferior portion of the orbit; great care being taken that the eyeball is not injured. The blades of the forceps should cut through the nostril and floor of the orbit to the spheno-maxillary fissure; the malar bone should be cut through its middle, right back to the anterior extremity of the same fissure; and the hard palate, on the same side of the septum nasi, should be cut back to the posterior border. Thus the tumor and bone will now only be held by a few attachments of soft tissue, which the knife easily separates. The bone can then be removed with slightly forcible manipulation, or by twisting it in the grip of a pair of strong forceps.

The hemorrhage in such an operation

is usually greater from the flap than from the rest of the exposed surface; but generally subsides in a short time, so that many ligatures are rarely requisite. The hollow left by the removal of the bone should be partially filled with wet lint, and the edges of the flap secured as already described. In such operations the patient should sit in the upright position, that he may readily get rid of the blood from his mouth. Chloroform should be administered by an experienced person; for its action can only be kept up by its being applied on a sponge or towel.

Tumors of the upper jaw vary so materially in size, in prominence, and direction, in their point of origin, and in many other circumstances, that, in the direction and extent of the external incisions, much latitude must be given, and much left to the judgment of the surgeon. Langenbeck has described several operations for the removal of tumors of the face. The peculiarity of these operations is, that he has endeavored to separate the periosteum from the bone (when necessary to remove the latter), and to preserve the former in connection with the soft parts. He believes that he has obtained recovery without deformity by so doing; while, if he had removed the periosteum, deformity would have resulted.

He has also adopted an operation, which he terms osteoplastic resection of the upper jaw. [This operation would appear to be attended with even more risk than when the bones are absolutely removed, probably from offering less space for manipulation, and thus embarrassing the surgeon's movements. In Mr. Hewett's case the patient sank before the operation could be completed. (Ashhurst, in Am. ed. of Erichsen.)] This operation is performed when the origin and growth of the tumor is behind the superior maxillary bone, but cannot be reached without displacing that bone.[1] Instead of removing the superior maxilla entirely, the requisite external incisions are made down to the bone at once, the bone sawn through in the same incisions, and the portion thus partially detached forcibly turned inwards, without otherwise dividing it from its connections with the nasal and frontal bone. The tumor is then removed from behind the bone, and the latter replaced in its original position. No incision is made at the place where this fracture or bending must necessarily occur.

Langenbeck's observations, and the cases he records, are too lengthy for us to introduce here; we must therefore refer the reader to the original.[1]

[1] As in Mr. Hewett's case, referred to on p. 528.

Diseases of the Pharynx.

Congenital defects of the pharynx are rare, and when they occur are associated with such other conditions of the fœtus as to render them incompatible with life; so that no practical importance attaches to their consideration.

Inflammation of the pharynx is generally a continuation of a similar condition of the fauces and soft palate, but is, though very rarely, seen to exist alone. When complicated with inflammation of the fauces and glottis, the inflammation appears to partake of the erysipelatous and diffuse character, and often terminates in purulent infiltration of the cellular tissue.

The general conditions indicative of this form of inflammation will be considered under the head of œdema of the glottis, in the essay on Diseases of the Larnyx. Difficulty in swallowing; labored respiration; swelling of the throat, often observed externally; swollen and rounded uvula and margins of soft palate, hiding from view all behind them, are the prominent symptoms. The tongue soon becomes brown and dry, the lips covered with sordes. The patient dies suddenly in a spasmodic effort to respire, or gradually sinks. Usually death takes place at an early period, and often sooner than has been anticipated. A patient, well to-day, is attacked in the evening with sore throat and difficulty in swallowing; these symptoms are soon followed by great obstruction to respiration, entire loss of sleep, rapid pulse, and hot skin; in the course of three days, or four at latest, with all his faculties clear, and while able to direct by motion or writing those around him, the patient's head falls back, and he is dead.

[Granular sore-throat is a form of pharyngitis which is very common in this country. It begins as an ordinary quinsy or sore-throat, and by repetition becomes chronic. The follicles of the mucous membrane become thickened and hypertrophied, and often several of them coalesce, forming little ulcerations on the surface and containing a cheesy substance consisting of disintegrated epithelial cells. Abstinence from loud or continued speaking, and from hawking or attempts at coughing, and attention to the general health are the first essentials of treatment.

Locally iodoform will often be of great

[1] Deutsche Klinik, 1859, No. 48, p. 470; and 1861, No. 29, p. 281.

service, painted on the mucous membrane in the strength of four grains to the ounce of glycerine. Nitrate of silver, thirty grains to the ounce of water, is even more useful, and should be employed daily. If the little elevations or granulations show no disposition to yield, they must be cauterized two or three at a time until they have all been destroyed. A mixture of equal parts of caustic soda and quicklime (London paste) is the best for this purpose.]

If the parts be examined after death, there will be found œdema of the submucous areolar tissue, around and in the substance of the constrictors, and travelling down around the œsophagus as low as the cardiac extremity. Often the areolar tissue is the seat of purulent infiltration. The treatment of such cases is most frequently hopeless. As long as the patient can swallow, as long as the mischief stops short of purulent infiltration, there is hope of recovery, and encouragement to persevere with the administration of stimulants and nutritious fluid food, if they can be swallowed; or with enemata of wine, quinine, and beef-tea. Laryngotomy should be performed when danger of suffocation becomes evident, or if the patient is suddenly attacked by spasm of the larynx threatening immediate death. Even if the benefit from laryngotomy be not permanent, it affords much immediate relief to the distress of the symptoms, and certainly prolongs life in most cases.

W. S., aged 45, was admitted on the 29th September, 1845, into St. George's Hospital, with difficulty of breathing and swallowing, and all the symptoms of diffuse cellular inflammation, extending down the pharynx and œsophagus. On the 2d October, at five A. M., he was attacked with a paroxysm of dyspnœa, and became quite black in the face and insensible. Laryngotomy was at once performed; and after artificial respiration had been kept up some time, consciousness returned; but it was found that the patient was utterly unable to swallow anything, and he died the following day. The effusion of lymph extended from the cellular tissue round the glottis downwards around the œsophagus, in the anterior as well as the posterior mediastinum, as low as the diaphragm.[1]

It will be evident to the reader with the above case before him, that when the mischief extends beyond and below the pharynx, and the infiltration is of a purulent character, no possible advantage can be derived from any form of treatment. The patient dies, either in a paroxysm of dyspnœa, or poisoned by the pus locked up in the cellular tissue of the thorax.

[1] Post-mortem and Case Book, 1845, No. 234.

Abscess of the pharynx is an occasional occurrence; is generally a formidable evil; and is often, as a cause or result, connected with some disease of the cervical vertebræ. [It sometimes arises from traumatic causes, as where foreign bodies become impacted in the pharynx. It progresses gradually attended with soreness of the throat, difficulty in deglutition, intermittent attacks of dyspnœa—but no loss of voice—snoring respiration, the presence of an elastic or fluctuating swelling behind the pharynx, which can be felt with the finger, and is often accompanied at some stage with rigors followed by fever.

The abscess should be opened at the earliest possible moment, preferably by the aspirator; if that cannot be procured, by a guarded bistoury, bearing in mind the danger of suffocation from the entrance of pus into the larynx.] Much care must be taken to arrive at a correct diagnosis of such a case; for it may readily be mistaken for a polypoid or other solid growth of the walls or cavity of the pharynx.

[Gummy tumors occasionally invade the pharynx during the advanced stages of syphilis. They are usually found either in the soft palate or under the mucous membrane of the posterior wall. When in the latter situation they should be carefully diagnosed from retro-pharyngeal abscess. Usually some concomitant symptoms of syphilis are present. The little tumor disappears rapidly as a rule under the free use of iodide of potassium.]

The following case well illustrates the importance of this precaution: An abscess, the size of a pigeon's egg, was situated between the bodies of the upper cervical vertebræ and the back of the pharynx, but from being flattened in front, did not cause any material projection of the posterior wall of the pharynx. In connection with the abscess, a second small cyst was prolonged forwards, so as to form a nipple-like swelling in the pharynx; and this compressed and completely closed the orifice of the glottis. The aperture of communication between this process and the body of the abscess admitted the point of the little finger; and the whole swelling was freely movable and perfectly translucent at its extremities and sides. This abscess occurred in an infant seven months old, who had suffered from dyspnœa for three weeks. The difficulty of breathing became very urgent three days before death; was constant, though less urgent at intervals; but the slightest exposure to cold, any motion or excitement, brought on a recurrence of threatened suffocation, attended by a peculiar croupy inspiratory sound. There was no attendant difficulty of swallowing, and no other disease was found after death.[1]

[1] Trans. of Path. Society, vol. i., p. 61.

Abscess may arise from an injury to the pharyngeal mucous membrane, caused by the passage or the impaction of a foreign body. In the Museum of St. George's Hospital is a preparation which shows an irregular ulcer, communicating with an abscess, on the posterior wall of the pharynx, which was removed from the body of a young woman who died from its effects, and who had, some six weeks previous to her death, swallowed some pins, one of which was supposed to have lodged in the pharynx, and produced the mischief which so speedily terminated in death.

Ulceration of the mucous membrane of the pharynx is usually the consequence of syphilis; more rarely it is the result of scrofulous influence. In children, the latter condition is sometimes observed to produce considerable destruction of the soft tissues, and its progress is very difficult to control. The symptoms generally are, offensive breath; offensive purulent secretion from the nostrils, and excoriated nasal apertures; constant cough; and the external characteristics of a strumous diathesis. The ulceration is readily seen when the mouth is opened; is not deep, but irregular, and the edges of the ulcer usually well defined; with crusts of dried secretion, often highly offensive, sticking in patches to its surface. There is not much pain complained of; perhaps some, less or more, is experienced when food is taken.

This characteristic form of ulceration is extremely obstinate in duration, and often extends to the tissues of the soft and hard palate, as well as to the nares. In the case of a little girl in St. George's Hospital, the mischief spread most unrelentingly from the pharynx to the nose and mouth, and from the mucous surface to the deeper tissues; until the nose fell in, and the greater portion of the palate, soft and hard, was destroyed, leaving the child a dreadfully disfigured object.

This strumous form of ulceration is certainly found to exist in children more frequently than in adults. The treatment is to be directed chiefly to constitutional measures, though local applications may also prove beneficial. It should consist of the various tonics, which are beneficial in the management of scrofulous cases generally, aided by good living, great attention to cleanliness and pure air, and, if within the means of the patient, a seaside residence; the Isle of Thanet is especially to be recommended.

Syphilitic ulceration of the pharynx is very commonly observed, especially in the lower classes of the metropolis. It is constantly seen to attack the posterior wall of the pharynx; but is usually accompanied by ulceration of the velum or tonsils, or some other secondary evidence of the prevailing poison.

[The primary sore of syphilis is sometimes, though rarely, found in the pharynx. It is, as might be supposed, the result of unnatural sexual relations, is commonly found in women, and is almost always situated upon one of the tonsils. It appears as a superficial ulcer with indurated base, or as a mere erosion. There is usually enlargement of the glands about the angle of the jaw. Although occasionally such sores have been known to take on phagedænic action, as a rule, they run their course without giving rise to any marked local disturbance.]

Its character may be suspected by the age of the patient, the period of its duration, and other symptoms which may be present; *i. e.*, rupial sores in the skin; nodes of the skull or other bones; pains in the limbs or joints; general reduction of health and flesh; and last, not least, the confession (not always to be obtained) of a former primary sore, with perhaps a mark of its recent habitation.

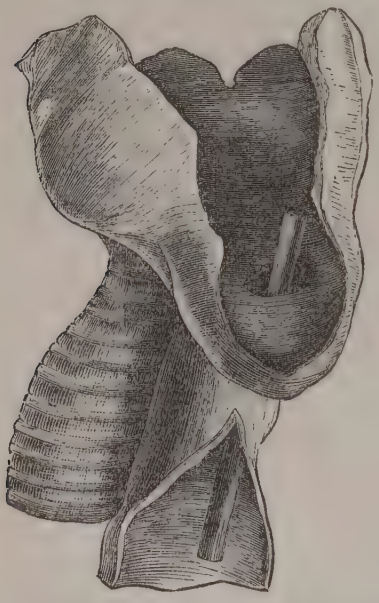
Such an ulceration will usually yield rapidly and satisfactorily to treatment. It granulates, contracts, and cicatrizes under the influence of iodide of iron, or iodide of potassium alone; and if thus treated in its earlier conditions, leaves behind but little to mark locally its former existence. [See note, p. 499.]

It happens, however, in some instances — whether from neglect, or from misapplied treatment, or from a state of deteriorated constitution—that there arises a greater virulence in this ulcerative action; and that the ulceration spreads not only to the sides and posterior wall of the pharynx, but also implicates the velum and arches of the palate, leaving a very extensive surface entirely denuded of mucous membrane. Under such circumstances, the patient will be found in a deplorable state; he has great difficulty in swallowing, and he becomes greatly reduced from inability to take sufficient nourishment. When, under judicious treatment, cicatrization commences, it will generally be found that as the ulcerated surface contracts, the soft palate becomes displaced, and adherent by its margins to some portion, or occasionally to the entire surrounding surface of the pharyngeal wall. [One case which occurred in my practice resulted fatally from cicatricial stenosis following syphilitic ulceration of the pharynx. The bands of fibrous tissue were so thick as to prevent the entrance of air during a temporary attack of bronchitis, the excess of mucus becoming entangled in them and giving rise to asphyxia. I performed laryngotomy on the instant, but the patient died within a few moments.] As a result,

the soft palate has been occasionally seen adherent to and continuous with the wall of the pharynx, so that all communication between the latter and the nares was entirely cut off. An operation should be attempted partly to relieve this evil; there is usually much difficulty in again preventing adhesions of the parts during cicatrization; but as the sense of smell is very much impaired as long as the communication between the two cavities is closed, it is most desirable to establish a permanent aperture in the soft palate under such circumstances; and in all probability the perseverance of the surgeon in his efforts to effect it will ultimately prove successful.

Dilatation of the pharynx may occur in two forms; it may be dilated throughout, or only partially. The latter condition is met with occasionally; the former very rarely. The symptoms noticed in cases in which a pouch has been found after death, are difficulty in swallowing much food, and vomiting of food which has been felt to stick in the throat. In one case[1] the patient (who died at the age of ninety)

Fig. 367.



Pouch of the pharynx. (From a preparation in the Museum of St. George's Hospital, Ser. ix., No. 14.

was accustomed to press on the pouch and force the food into the œsophagus. [It is said that this condition occurs usually in persons who have been accustomed to bolting their food.]

[1] Museum of Royal College of Surgeons, No. 1886.

In the Museum of St. George's Hospital is a specimen showing dilatation of the lower part of the pharynx, at a point corresponding to the lower border of the inferior constrictor muscle, and forming a pouch equal in size to that of an egg. The pouch projects downwards behind the upper part of the œsophagus; it is apparently composed of a portion of the mucous membrane and sub-mucous tissue protruding through the muscular coats of the pharynx, and does not show any muscular fibres entering into its formation. [It was thus really a *hernia* of the inner tunics of the pharynx. The same condition was found by Rokitansky, who made a post-mortem in a case where the symptoms had existed for forty-six years. The walls of the pouch contained only a few bands of pale muscular fibres.] The upper portion of the pharynx is enlarged, and the pharyngeal muscles are hypertrophied. There is no stricture of the œsophagus.

The preparation was removed from the body of a man aged sixty-three, who for several years had suffered from difficulty in swallowing. After the conclusion of a meal he was in the habit of returning small portions of food. For two or three years previous to his death he was subject to attacks of inflammation of his larynx, from which he recovered under treatment. His death was the result of inflammation of the lungs. The dysphagia was always supposed to be owing to stricture of the œsophagus.

Tumors attached to the pharynx are not very common. When they occur, they are generally apt to be somewhat pendulous, and are often attached to a portion of the walls by a narrow neck. They have been found to consist of fat, fibrous or fibro-cellular tissue. But the character of the growth is perhaps of less importance as regards the immediate treatment, than the shape, the size, the position, and the attachment of the mass.

[Papillomata are not very rare; vary in size from a pea to a small grape, and are usually found situated on the pillar of the fauces.]

The record, with a colored illustration, of a fatty tumor of the pharynx, is to be found in the Transactions of the Pathological Society, vol. v., p. 123, by Mr. Holt. This specimen was removed from the body of a man eighty years of age. Twelve years previously his attention had been first drawn to his throat, from an occasional sensation of choking. About four years previous to his death, during an attack of vomiting, a large mass was protruded into the mouth; and, to prevent immediate suffocation, he was compelled to return it as quickly as possible. He was at all times better able to swallow fluids than solids. He died suddenly, while in the act of smoking.

The tumor was found to be a large, pendulous, fatty mass, filling the pharynx, and extending downwards into the œsophagus for nine inches. It was attached by fibrous tis-

sue, covered by mucous membrane, to the left side of the epiglottis, and also to the upper part and side of the pharynx. The tumor had by its weight so dragged upon the epiglottis that the perfect closure of the laryngeal aperture was not practicable. The mass, except at its attachments, was hanging loose in the pharynx and œsophagus. It consisted of adipose tissue.

In the Museum of the College of Surgeons are two specimens of tumors of the pharynx, successfully removed during life. One[1] is a large, soft, lobulated mass, apparently fatty or gelatinous, like a nasal polypus. It was attached by a narrow pedicle behind the tonsil. A second[2] is apparently a firm, fibrous mass, and was attached by a narrow pedicle to the wall of the pharynx. [Voltolini reports the case of a small fibroid growth about half the size of a pigeon's egg, springing from the posterior wall of the pharynx. Fischer describes a tumor, apparently sarcomatous, which extended from the base of the skull to the cricoid cartilage.—(Mackenzie.)]

Other cases have been observed in which tumors, either of a fatty or fibrous structure, have encroached on the cavity of the pharynx, without becoming pendulous; they have been seen to grow and insinuate themselves under the mucous membrane; and as they increased in size, so they interfered with the aperture of the glottis, and interrupted the passage of food to the stomach.

The treatment of tumors located in and attached to the walls of the pharynx is often attended by much anxiety, as their removal is an operation of much hazard. But that their removal should be had recourse to, and that that removal should be undertaken at as early a stage as possible, we need not attempt to impress upon the reader.

The only hope of benefit must be from treatment restricted to the pendulous form of tumor. The attempt to remove a tumor attached throughout to the walls of the pharynx would be a highly hazardous proceeding, and most probably unsuccessful in its results, if not fatal during its progress. When the tumor is pendulous, no time should be lost before the endeavor be made to remove it. If not large, and attached to the upper part or side of the pharynx, it may be seized with a vulsellum, and the pedicle cut through with a knife. If the mass appears very vascular, or large vessels are detected running through the pedicle, a double ligature may be first passed through the base, and when securely tied the mass may be with safety cut off beyond it. A ligature through the pedicle is far preferable to one round it; for when the mass beyond is removed by the knife, the latter is apt to slip off, and possibly some hemorrhage might ensue.

The chief, and probably the only risk the surgeon has to fear in an attempt to remove a polypoid mass from the pharynx, is that of suffocation, produced either by the mass itself filling up the fauces and pressing down the epiglottis, or by spasm of the glottis, the result of irritation from the tumor coming in contact with the surface of the laryngeal mucous membrane. If the character of the tumor recorded in the Transactions of the Pathological Society by Mr. Holt be considered—its attachments, its size, and the extreme feasibility of its removal, either in great part or in its entirety, *supposing* there was no risk of suffocation; if it be remembered that the tumor could not have been drawn into the mouth without the aperture of the glottis being stopped up, but that otherwise the mass might easily have been drawn forwards, and the greater portion removed, would it not be justifiable, we ask, under all such circumstances, that, prior to an attempt being made to remove such a tumor the precaution should be taken to perform laryngotomy, and to introduce the tube into the larynx as a safety-valve for the patient to breathe through while the operation was in progress? We should have no hesitation to perform this operation under circumstances such as were attendant upon the case related, and prior to a proposed removal of a tumor; nor have we any hesitation in recommending the adoption of such a precaution under similar conditions. The operation of laryngotomy is simple; it is so safe in its results, provided the parts are in a healthy condition, that no danger of irritation need be apprehended from the introduction of the tube. The author operated himself, and witnessed several other instances in which the operation had been performed on patients under the care of the late Dr. Marshall Hall for the relief of epilepsy; and in no case was there the least approach to danger from the operation itself, or from the presence of the tube in the larynx. Under circumstances similar to those related by Mr. Holt, laryngotomy would insure the safety of the patient's life during an attempt made to remove a pendulous mass from the pharynx through the mouth; and the tube might be retained until reparation took place in the wound occasioned by the removal of the tumor.

[Cancer in the lower portion of the pharynx is usually included in the consideration of cancer of the œsophagus. Cancer of the upper portion, or of the pharyngo-oral cavity is much rarer. Out of 8289 deaths from cancer in the Paris registers, three were ascribed to cancer of

[1] No. 1090. [2] No. 1091.

the tonsils and four to cancer of the pharynx. It is usually of the scirrhous variety; begins as a hard mass in the submucous tissue, and runs the usual course.]

Diseases of the Œsophagus.

Congenital malformation of the œsophagus is rare. It usually proves fatal within a few days of birth.

Dilatation of the œsophagus, and *pouches* connected with that tube, are morbid conditions of occasional occurrence. Cases of the former have been put on record by Rokitansky[1] and by Dr. Barker.[2]

Contraction of the œsophagus is a very common evil. It is usually an insurmountable difficulty to the surgeon, and in the majority of cases rapidly reduces and destroys its victim.

Contraction, or "stricture" of the œsophagus, may be the result of several distinct conditions. Folds of the mucous membrane; cicatrices after injury; pressure occasioned by neighboring tumors; thickening and contraction of the walls; or, lastly, and most frequently, cancerous affections of the tube, are the chief causes of stricture of the œsophagus.

[Dr. Harrison Allen, after analyzing a number of œsophageal obstructions from different causes, concludes that the portions of the tube most liable to stenosis, either by disease or mechanically, are that behind the cricoid cartilage, and that which is crossed by the left bronchus.]

In the Museum of the College of Surgeons is a specimen (No. 1079) which shows stricture of the œsophagus from a fold of mucous membrane. Just below the cricoid cartilage the œsophagus gradually contracts to half its diameter, and then dilates. The mucous membrane at the contracted part forms transverse sharp-edged and projecting folds, which pass round the chief part of the circumference of the tube. The surrounding tissues are also condensed, as if the result of cicatrix. There is no history to the specimen. Another preparation (No. 1080) shows a very similar condition in the œsophagus of a child, probably the result of some acrid substance having been swallowed. A preparation removed from the body of a boy ten years of age shows a contracted state of the œsophagus, subsequent to the action of sulphuric acid swallowed during life. With respect to the changes subsequent to the passage of an acrid poison over the mucous surface of the œsophagus, Rokitansky remarks that when "the mucous membrane has been destroyed by the energetic action of the poison, it is replaced by serous and sero-fibrous tissue, which gives rise to peculiar valvular strictures of the œsophagus, somewhat analogous to those consequent on dysentery."[1]

In the Museum of St. George's Hospital is a preparation of a portion of an œsophagus, in which may be seen a constriction about three inches from its upper extremity—the result of a piece of bone becoming impacted for a time in the passage, and having set up inflammation around the part. This mischief extended to the præ-vertebral areolar tissue of the cervical region, followed by ulceration of the inter-vertebral cartilage of the third and fourth cervical vertebræ. The ulceration went on to perforation of the spinal canal, and produced inflammation of the membranes and softening of the spinal cord. The piece of bone, of considerable size, had stuck in the throat for a time, but was subsequently removed. Large quantities of pus were afterwards spat up.[2]

Simple stricture of the œsophagus, from thickening and contraction of its walls, is occasionally met with, and apparently without satisfactory explanation. Mr. Liston exhibited at the Pathological Society a specimen possessing some interesting features. The stricture existed at the upper part of the tube, was about an inch in length, and only capable of allowing the passage of a goose-quill. The contraction had existed for a number of years; there was considerable hypertrophy of the constrictors of the pharynx, especially of the superior one. The upper horns of the thyroid cartilage were so approximated as to leave but a space of five-eighths of an inch, being a diminution of about an inch in the breadth of the natural interval between them. The patient had been under the care of Cruikshank and John Hunter, and lived to between seventy and eighty.

It is unnecessary to multiply instances of these forms of contraction; there are, however, certain circumstances in connection with their progress, which will form the subject of consideration when their diagnosis and treatment are discussed.

Complete obstruction to the passage of food from the pressure of a tumor on the œsophagus is very rare. Occasionally some degree of difficulty in swallowing is experienced, from the presence of a tumor of a cancerous nature; or from the thyroid, when very large, or when it wraps round the trachea; or from an aneurism or any other kind of swelling in the neck.

Evidence of supposed pressure from a tumor must, however, be carefully weighed, before a decision be arrived at respecting its influence in this respect. Dr. Wilks[3] has very properly drawn attention to the circumstance, that obstruc-

[1] Path. Anat., vol. ii., p. 8.
[2] Path. Soc. Trans., x., 140.

[1] Path. Anat., vol. ii., p. 10.
[2] Post-mortem Book, 1852, fol. 36.
[3] Path. Soc. Trans., vol. xii., p. 101.

tion has been attributed to an exostosis of the vertebræ when actual disease of the œsophagus and stricture existed above the seat of the exostosis.

The most frequent causes of obstruction to the passage of food, attended by rapid deterioration, and followed by early death, are cancerous affections of the œsophagus. They occur in various forms. The epithelial variety of ulceration with contraction is most common, but medullary, villous, or colloid cancer occur somewhat in proportion to the order in which we have placed them.

Cancerous ulceration or stricture of the œsophagus is a disease of age. We are not aware of its occurrence in youth or early life. Rokitansky states that "cancer of the œsophagus generally occurs in an isolated form, *i. e.*, without the coexistence of the disease in other organs."[1] Such is no doubt often the case, but the rule is made too general to be correct; the reader must satisfy himself that we differ with the great pathologist on reasonable grounds, by reference to the Transactions of the Pathological Society.

The usual symptoms of stricture are, first, a slight difficulty in the passage of solid food to the stomach. The difficulty gradually increases; sooner or later the patient is compelled to restrict himself entirely to food of a fluid form. By degrees he finds that this he can take only in gradually reduced quantities, until at last he sips but a few drops at a time; or even this small quantity may be rejected, shortly after an attempt made to swallow it.

A patient with stricture of the œsophagus rapidly emaciates; he visibly deteriorates in physical power and in substance from day to day; the circulation becomes feeble, he complains of a sensation of cold on temperate days, and he becomes very susceptible to all changes of the atmosphere.

If there be ulceration in the upper part of the œsophagus, or the pharynx be also implicated, there is generally a disagreeable smell in the patient's breath, easily detected by a visitor on entering the room. The patient is often subject to expectoration, and the secretion spat up is semipurulent, and occasionally very offensive. He complains of intense hunger in the earlier period of the disease, and when solid food can no longer be taken; but gradually he succumbs to the privation, and latterly is often indifferent respecting it.

When once the patient is restricted to fluid nourishment alone, the quantity taken is by no means sufficient to sustain life; so that the medical attendant may predict the approaching end as not far distant, when perhaps the patient or his surrounding friends may be little prepared for such an announcement.

Occasional complications occur in the progress of stricture of the œsophagus to which our attention is requisite; they render the disease more distressing to the patient, but generally hasten the termination of his sufferings. The epithelial variety of ulceration is apt to spread superficially without destroying the tissues deeply; and though a large surface may be implicated, the patient so affected will survive longer than one affected by the medullary form of cancer. With the latter form of disease the surrounding tissues become implicated at an early period, and thus the passage may become much constricted soon after the disease is suspected. Ulceration of the tube above or about the diseased mass will generally take place, and cavities in the cellular tissue around will be constantly found communicating with the ulcerated points of the œsophagus. Occasionally the destruction makes its way outwards, until several openings are formed externally about the neck, and allow the escape, not only of matter, but also of the fluids taken as nourishment. Or the ulcerative action may run in a different direction, burrow about the muscles of the neck, or effect a fistulous communication with the trachea. The latter condition is made evident by fluids, taken through the mouth, being coughed up through the glottis.

In other instances, almost instantaneous death will occur from sudden and violent hemorrhage, dependent on the ulceration of a large artery.[1]

The symptoms of stricture of the œsophagus are so marked, that it might at first sight appear almost impossible to be deceived regarding its occurrence. But an hysterical spasmodic condition of the pharynx or œsophagus is occasionally met with, and might be mistaken for organic mischief, without some precaution and judgment brought to bear on the case. It is therefore prudent to weigh carefully the symptoms of all cases of supposed stricture of the œsophagus, in order to be able to discriminate between

[1] Pathological Anatomy, vol. ii., p. 12.

[1] A case is recorded in the Transactions of the Pathological Society (vol. ix., p. 194) of death by hemorrhage from ulceration extending from the œsophagus to the right subclavian artery. And a second instance is found at page 202 of the same volume, in which death was the result of perforation of the superior intercostal, by extension of ulceration from the cancerous stricture. The vertebral artery has been known to be perforated under similar conditions.

actual stricture and that of nervous origin. The latter disorder is not very commonly met with; but it will be found, as a rule, to occur in women. In two instances familiar to us, the symptoms were evidently entirely due to the state of health, and yielded effectually to constitutional treatment. The symptom which commonly distinguishes an hysterical or spasmodic difficulty in swallowing from a real stricture is the manner in which a patient can swallow fluids, or even solids, when allowed to take them apparently unobserved. There is little, if any, emaciation; nor is there the early indication of loss of strength; nor the constant desire for food if it could only be swallowed.

The diagnosis of stricture of the œsophagus is generally very easy and sure. It comes on after mid-life. The patient experiences a constant craving for food, but an inability to partake of it. He longs for it, and would at any moment partake of a large meal, if it could possibly pass to the stomach. "You know nothing of the pangs of hunger," observed an eminent member of our profession, when dying of cancerous stricture of the œsophagus. "Day and night I suffer horrible tortures from absence of food from the stomach; but I can swallow nothing."

When a pouch of the pharynx or œsophagus exists, it may be suspected, if, after partaking of food, the patient feels any fulness in the neck, or if, after a time, a portion of the meal is returned. As the pouch is capable of holding a certain quantity, there is not so much difficulty in disposing of a portion of solid food as in stricture; for a part may pass into the œsophagus, and the rest into the pouch. A patient suffering from a pouchy condition of the tube does not emaciate so rapidly as one affected by stricture; several instances on record having lived to a good old age. [The œsophagus above the stricture is almost always dilated; below it is of normal calibre or slightly contracted.]

The treatment of stricture of the œsophagus is summed up in a very few words.

If hysterical, general constitutional treatment will overcome it, without much difficulty, in a comparatively short time.

If permanent, from cicatrix, or other disease, we can offer very little hope of benefit from treatment. When the result of cicatrix, or supposed folds of mucous membrane, the application of caustic has been recommended and tried. The use of bougies has perhaps been followed by some partial relief. But all treatment is, at the best, unsatisfactory. When cancerous, the treatment most suited to relieve suffering, and to soothe the distress of the patient's closing days, is the administration of enemata of strong beef-tea and laudanum; and at the same time, the allowance of whatever fluid he relishes, either to wash out the mouth, or to swallow. The enemata may be repeated with great benefit every four or six hours, according to the feelings or wishes of the patient. Such treatment will prolong life some days; and it may be a matter of very considerable importance to the surviving members of a family, that a life should be prolonged over a certain period, not far distant, when the medical attendant is first consulted.

[Fig. 368.

Cancerous stricture of the œsophagus.]

We cannot recommend the use of bougies in the treatment of stricture of the œsophagus. In its early stage, curiosity may perhaps require to be satisfied by an exploration, so that the exact seat of the stricture be ascertained; and to such a proceeding there is no great objection. But, beyond this, very little, if anything, is gained by such treatment.

[Œsophagotomy or gastrostomy may be resorted to in certain circumstances. The first operation is justifiable, according to Agnew, when a foreign body is immovably impacted in the cervical portion of the tube; when a malignant growth in the pharynx or at the commencement of the œsophagus prevents the passage of food; or when a morbid growth may be removed thereby which cannot be reached through the mouth. Of thirty-six cases of œsophagotomy given by him twenty-seven recovered and nine died. All the recoveries were in cases where the operation was performed for the removal of foreign bodies. Of fourteen cases men-

tioned by Ashhurst, in which the œsophagotomy was for the relief of stricture, four recovered. Gastrostomy has been performed a number of times, but not with sufficient success to warrant a resort to it unless in cases absolutely hopeless from other means. Of course, when the cause of the stricture is carcinomatous, any operation could only have the effect of prolonging life slightly, if at all. Of the thirty-four recorded cases of this operation, thirty-two terminated fatally.]

In attempts made to pass a bougie through the stricture, the end of the instrument has been known to find its way into the mediastinum; into the cavity of the pleura; and into the cavity of the pericardium. In each instance the instrument was used by skilful hands; but, in all the cases, rapid death supervened upon the severe symptoms which followed the withdrawal of the bougie.

It is wise in such cases to refrain from interference without some certain prospect of good; for in these cases, as in all, meddlesome surgery is bad.

[The use of a bougie or of a probang with an ivory or hard-rubber head may be needed for purposes of diagnosis. A fibrous stricture is felt with these instruments to be smooth and regular, and very slight bleeding, or none at all, results; a cancerous stricture gives the sensation of a rough uneven surface, and the withdrawal of the bougie is followed by a sanguino-purulent discharge.]

SURGICAL DISEASES CONNECTED WITH THE TEETH, AND THEIR TREATMENT.

By S. James A. Salter, Esq., F.R.S.

Revised by James Truman, D.D.S.

The limited space allotted to this essay compels me to forego, to a great extent, dwelling on those diseases which most commonly fall under the special care of the dentist, and to confine myself, almost entirely, to those surgical *complications* which are associated with, and dependent upon, abnormal conditions of the teeth.

The subject of "teething," and the ailments of childhood contingent on the process; the irregularities and deformities depending on the shedding of the temporary teeth, and the advent of their permanent successors, would alone occupy, if treated with justice to their importance, more space than can be afforded to the entire essay.

Another matter which is of the last importance in the treatment of the teeth, *stopping* or *plugging* carious cavities and other defects of surface, is a subject of such extent, and involves so much preliminary discussion upon purely physical questions, that it is impossible to enter here upon its consideration. Indeed, the treatment of those most usual and ordinary abnormalities of the teeth, irregularities of the position of the permanent set in young people, and carious cavities, entail to so great an extent a particular mechanical knowledge in combination with surgery, both its science and art, that it has naturally, and indeed inevitably, assumed that *special* character of practice and of surgical treatment which we see at present accorded to it; and for these reasons, combined with the want of space which I have before mentioned, I am constrained to refer the reader, for the consideration of these subjects, to those works which have been specially devoted to their elucidation.

In the following pages, therefore, I shall describe, as far as my limits allow, those surgical diseases and abnormalities, with their treatment, which are more or less connected with the teeth, under the following heads:—

[Periodontitis.]

I. Alveolar abscess.

[Pyorrhœa alveolaris.]

II. Painful and difficult eruption of the wisdom-teeth.

III. Tumors of the gum.
   (*a*) Epulis.
   (*b*) Congenital hypertrophy of the gum and alveolar borders of the maxillæ.
   (*c*) Polypus of the gum.
   (*d*) Vascular tumors.
   (*e*) Warty tumors of the gum.

IV. Tumors of the tooth-pulp.
  (*a*) Polypus of the tooth-pulp.
  (*b*) Sensitive growth of pulp after fracture.

V. Odontomes, or tumors of the hard tissues of the teeth.
  (*a*) Enamel nodules.
  (*b*) Exostosis.
  (*c*) Hypertrophied fangs.
  (*d*) Dentine excrescence.
  (*e*) Warty teeth.

VI. "Abscess" of the antrum.

VII. Dentigerous cysts.

VIII. Alveolar and maxillary necrosis from
  (*a*) Phosphorus fumes.
  (*b*) Eruptive fevers.

IX. Hemorrhage after extraction.

X. The application of obturators and artificial palates.

[*Periodontitis.*—In order to arrive at correct conclusions in regard to alveolar abscess, it is necessary to understand the processes that lead to it, and the pathological conditions that invariably precede it.

Inflammation of the periosteum of a tooth may be the result of various causes, some of which tend to merely temporary lesions, while others assume chronic conditions. Continued pressure upon a tooth, as in regulating teeth, will cause a temporary disturbance, the tooth assuming all the pathological conditions usually observed in periodontitis proper, but which, on removal of the pressure, disappear entirely. Chronic inflammation may be observed in cases of marked systemic degeneration; in local disturbance, as in mercurial ulitis, scorbutus, or absorption of the membrane from any cause.

The acute form of periodontitis is generally the result of the destruction of the pulp, for where the vitality of that organ is perfect, periosteal inflammation, except in the subacute form, is rarely possible. The destruction of the pulp is, therefore, a pre-requisite to the pathological condition we term alveolar abscess, and while there may be acute forms of periosteal inflammation from local irritation, alveolar abscess proper can only occur through the process first named.

The causes of pulpitis are many, but the principal are caries, blows destroying continuity, abrasions, pressure from irregular formations of secondary dentine, irritation of the dentine from metallic fillings, etc.

While caries has more to do with the destruction of the pulp than all other causes combined, it rarely produces this effect unless the progress of the disease has extended to the exposure of some portion of the organ. That this frequently occurs through long-continued irritation of the sensitive dentine, in advance of exposure, there can be no doubt. Whether the destructive cause be internal, as caries, or external, as by a blow, the effect will eventually be the same, provided proper methods are not resorted to to preserve the life of the organ. In the latter case the difficulty of diagnosing the exact condition of the tissue at the foramen renders the subject obscure and treatment impossible, until discoloration indicates the true condition of the pulp.

The destruction of the pulp through the irritation of caries is usually very slow, and a tooth may remain for a long period comparatively comfortable; but whether the inflammation completes its work by slow or rapid approaches, the destruction and subsequent decomposition of the organ is the result. The irritation extends beyond the tissue first attacked, and, eventually, the periosteum of the tooth becomes the seat of inflammatory conditions. This is indicated by pain on occlusion with opposing teeth, or by percussion, which may be slight or severe, depending on its stage of progress.

When the periostitis proceeds from a devitalized pulp, the periosteum suffers in proportion to its contiguity to the foramen, or, in other words, that portion of the tissue nearest the opening will be in a state of acute inflammation, while that more remote or nearer the gingival border may be comparatively free. On the other hand, that beginning at the neck of the tooth may exist without disturbing the vitality of that at the apex of the root. It is not uncommon to find the periosteal border at the gum entirely destroyed and the subjacent tissue necrosed, as in pyorrhœa alveolaris, and also a high degree of inflammation on one side of a root, and the balance, on the opposite, in an entirely healthy condition. One root may, also, be affected, and not the others, or they may all be involved, though this is a very rare presentation.

Periodontitis may extend, in the chronic form, over long periods without perceptible change, or, as in the acute form, rapidly terminate, unless aborted by treatment, in alveolar abscess.

The *treatment* of periodontitis must be, in the first stages, principally of an antiphlogistic character. The hyperæmic condition requires active counter-irritation in some form. This may be combined with systemic treatment, but the local treatment is the most to be depended upon in the early stages. The gum over the tooth affected should be freely lanced, making an incision to the alveolus. Effort should be made to increase the flow of blood, by the use of warm water. The

wound should be kept patulous by the use of a small piece of cotton. All causes of irritation must be removed. If the pulp-remains are in a decomposed condition, which is generally the case, these must be removed, and the canal in the root washed out with a five per cent. solution of carbolic acid. An application of greater strength than this becomes itself a source of increased irritation. If the pulp be not exposed, and the tooth by its blue color indicates devitalization, resort must be had to an artificial opening at some point most convenient; but this should not be attempted in the incipient stages, and comes more properly under the treatment of alveolar abscess. Topical applications may be resorted to. Tinct. of aconite root is a favorite sedative with some, being applied on a pledget of cotton, two to three drops. It should be used with great caution. Dr. Taft recommends this to be combined with equal parts of tinct. of opium and chloroform. Painting the gum with tinct. of iodine is frequently of great value. Tinct. of capsicum, tinct. of iodine and cantharides are also useful, but should be applied with judgment. In the more acute stage the application of a leech will be found very effective, and also the hypodermic injection of morphia may be resorted to to relieve the pain. It will be found, however, that that treatment will be most effective which most rapidly reduces the inflammatory condition. As internal arterial sedatives Dr. Garretson[1] recommends veratrum viride, and places especial reliance on bromide of potassium, prescribed in water in "doses of ten grains every two, four, or six hours." The most effective treatment is to combine the free lancing with cold applications to the tooth. The most convenient mode is through the agency of rhigolene spray. The cold produced by this agent is intense; it must be used with great care. The practice found most useful is, after freely lancing, to apply the spray directly on the tooth and not allow it to reach the gum tissue. The first application intensifies the pain, and the cold must be increased gradually. Two minutes will be quite sufficient, or there must be a cessation the moment the gum-border begins to change color. The spray may be applied several times within an hour, and it has been found necessary to repeat it at intervals through an entire day. When used judiciously this is by far the most satisfactory treatment, and rarely fails to abort the inflammation, unless that has extended beyond any treatment except that adapted for alveolar abscess. It should be remembered that rhigolene is a dangerous fluid to handle in proximity to fire, and should never be used on a patient where this in any form is in the room. This danger greatly limits the use of this exceedingly valuable agent.

When all the efforts that have been described fail to give relief, there is nothing more in the way of abortive treatment, and the tooth may be considered to have advanced to the second stage of alveolar abscess, and must be considered under that head.]

I. *Alveolar abscess.*—One of the commonest consequences of dental caries, and occurring occasionally independent of any apparent disease in the teeth, is this troublesome, and too often ill-understood, malady. The results of this condition, when appearing on the external surface of the face (cheek, jaw, or chin), are occasionally so remote from any obvious connection with the teeth, and the patient's symptoms so fail to indicate its association with them, that the true nature and cause of the suppuration is lost sight of, and an easily-remedied disease is indefinitely protracted.

Alveolar abscess may be defined as a suppuration around the fang or fangs of a tooth, usually carious, accompanied by absorption and expansion of the bony walls of the alveolus or alveoli, and the enlargement of the little pus-sac, the matter gradually finding its way to the surface either along a canal by the side of the fang of the tooth opening at the edge of the gum, or through the gum itself at a point corresponding to the end of the root (or roots) of the tooth implicated. When, however, the fangs are unusually long, or the reflection of the mucous membrane, from the gum to the cheek or lip, is very superficial, this same discharge may burrow still more outwardly, and find its exit upon the surface of the face.

The pathology of alveolar abscess, especially in its commonest form of "gum-boil," has not been generally understood. The first change which occurs in the development of this condition consists in the deposit around the extremity of the fang or fangs of the tooth of organizable lymph, which is soon differentiated into obscure fibrous tissue. Coincident with this development, the bone around the end of the tooth-fang becomes absorbed, and a little hollow in the jaw is produced, varying in size from a lentil-seed to that of a horse-bean. Thus far the change is simply one of plastic inflammation: it occurs, as far as my observations go, with every carious tooth, and in those with more than one fang is most conspicuous

[1 System of Oral Surgery, p. 154.]

at the extremity of that root which corresponds with the side or part of the crown where the caries occurs.

["The periosteum of the root presents a gradual increase in thickness towards the apex of the root, its tissue is compact, its outer surface not unfrequently like felt, and sometimes highly vascular. Besides the roundish or ovoid connective-tissue cells, rows of spindle-shaped elongated cells also are met with; later in the progress of the affection, wavy, curled bundles of connective tissue appear in the basis substance, between which rows of roundish cells are imbedded. In such localities the nerves and vessels undergo a perceptible wasting away, while the larger bloodvessels are expanded. The proliferating connective-tissue undergoes a partial involution (retrograde metamorphosis) which is manifested by the appearance of fat granules, partly within the protoplasm of the cells themselves, and partly in the intermediate substance; but, nevertheless, germs of proliferation may persist, which will be excited to renewed activity with the occurrence of an irritation.[1]"]

These changes are often accompanied by absorption, to a varying amount, of the extremity of the fang; and this appears to be part of the same action as produces the excavation in the maxilla itself, which is occupied by the plastic exudation. There is generally, too, a thickening of the alveolar periosteum, which raises, and often loosens, the affected tooth.

It is the lymph surrounding the extremity of the fang, and occupying the little cavity produced by the bone-absorption, that is the seat of suppuration in alveolar abscess. Whatever may be the first actual point of suppuration, when sufficient pus is formed for recognition, it is found in immediate contact with the fang of the tooth—the bare naked crusta petrosa, and surrounded by the half-organized lymph, as by a sac. The form of this sac varies considerably; it is usually spherical or pyriform where the fang is single, or if the tooth have more than one fang, and the fangs are distinct; but where the fangs are close together, or the root is simply cleft at its extremity, as is often the case with the superior premolars, the sac is frequently double and bilocular. The sac is sometimes of large size, and is frequently very long; sometimes it is fringed with fimbriated processes of lymph, which occupy an elongated excavation in the maxilla. When suppuration is established, the sac enlarges according to the amount of matter formed, and the rapidity with which it is developed; and this is accompanied with a dilatation and absorption of the bony walls of the abscess, especially towards the region at which the matter is "pointing." These latter changes are often very extensive and very rapid; so that the whole of the osseous tissue of one wall of the alveolus may be expanded and thinned into a mere papery film, and then completely absorbed in comparatively few hours, the periosteum, with the organized lymph that has been the seat of the suppuration, alone remaining as the membranous sac of the abscess. The development of an alveolar abscess is generally accompanied by a deep throbbing pain at the part affected, and often by great general swelling of the face, sympathetic of the more internal mischief. The distortion of the countenance from this cause is sometimes prodigious, especially when the upper incisors or canines are the cause of the abscess, and the attack is acute. In such a case the nose will be pushed on one side, the eyelids become œdematous, closed, and ecchymosed. In other instances, where the character of the affection is less intense, a mere indurated, indolent, and hard swelling on the side of the jaw is all that is produced; the maxilla being distended at the extremity of the tooth's fang, and but little bone absorbed.

The development of an alveolar abscess is sometimes associated with febrile symptoms of extreme severity. M. Robert[1] describes a case of alveolar abscess, resulting from a carious wisdom tooth, which led to necrosis of the surrounding bone, and diffuse purulent infiltration of the side of the neck. The case terminated fatally.

Alveolar abscess is usually confined to the tooth or one fang (when the tooth has more than one) which has been the cause of the affection, and around which the plastic exudation has formed. Occasionally, in two- or three-fanged teeth, the intervening bone between the extremities of the individual fangs becomes absorbed, and one abscess may be common to all. Again, there is another form of alveolar abscess which occasionally affects the upper jaw and front teeth in persons of cachectic and debilitated constitution, in which suppuration appears to affect generally the tissues surrounding the roots of several teeth in a diffuse manner: the teeth become excessively loose, and the front of the jaw around them becomes boggy and suppurates abundantly, the discharge usually flowing around the necks of the teeth. In such cases the teeth are often, indeed generally, sound, and are probably only secondarily affected. I incline to the opinion that this form of alveolar abscess is dependent on constitutional taint—scrofulous or syphilitic.

[1] Wedl, "Pathology of the Teeth," Lindsay & Blakiston, p. 209.]

[1] Conférences de Clinique chirurgicale, par M. A. C. Robert, p. 145. Paris, 1860.

The "pointing" of the matter in alveolar abscess is a question of some moment, both as regards diagnosis and treatment; and the circumstance that the discharge of pus may occur upon the surface of the face, entailing with it very great disfigurement, adds serious importance to this consideration.

An alveolar abscess affecting the one-fanged teeth may find vent for its secretion by a gutter or channel along the course of the fang, the matter being discharged at the neck of the tooth. This seldom occurs to the many-fanged teeth, and is most commonly seen with the inferior incisors—the pus flowing from the front edge of the gum at a point corresponding with the particular tooth affected. The commonest position at which the thinning and bursting of the abscess takes place is on the outer surface of the jaw, at a point corresponding, as nearly horizontally as may be, with the extremity of the fang of the affected tooth, and *piercing the gum within the mouth.* In such common cases the diagnosis is perfectly simple and obvious, and the abscess is easily associated with the individual tooth that produces it. There are, however, instances in which the pointing of the abscess, after having taken a lengthened and burrowing course, is remote from its cause. The most striking peculiarity of this kind is where a circumscribed collection of matter appears far back in the palate, occasionally at the very posterior extremity of the hard palate, generally dependent on affection of one of the six front upper teeth. [And has also been observed to proceed from the palatine root of the superior first molar.] Such a condition may readily fail to indicate its true explanation, and may suggest the presence of necrosed palatal bone; it is important therefore, in the practice of general surgery, to recollect that this obscurity may present itself. As far as my own experience has gone, caries of the *superior lateral incisor* tooth has generally been the cause of this remote pointing abscess. Why it should be so I cannot say; but the pathological anatomy of the affection is the same as in ordinary cases, only the canal of the abscess is lengthened out in the narrow cancellated bone between the two compact plates of the palatal process of the superior maxilla. A critical scrutiny of the front teeth (incisors and canine) will scarcely fail to show which is the offender.

The forms of alveolar abscess which we have just considered are trivial in their importance in comparison with those which, in their advancing course, involve the integument of the face. It is a curious circumstance that alveolar abscesses, when pointing externally upon the face, have been so frequently misunderstood by surgeons, having been mistaken either for idiopathic abscess in the substance of the cheek, or for suppuration associated with necrosis of more or less of the maxillary bones. To the superficial observer (and, indeed, in its consequences) there is a vast difference between a common gum-boil and an abscess which pierces and discharges its contents upon the surface of the cheek; but the cases are the same, barring the point where the pus is evacuated.

The circumstances which determine the pointing of an abscess upon the surface of the face appear to be either an unusual length of the fang of the tooth, or a superficial reflection of the mucous membrane from the jaw to the cheek; so that, in either case, the abscess which is forming around the extremity of the fang does not correspond horizontally with the gum within the mouth, and thus in its course outwards it passes either above or below (as it may occur in the upper or lower jaw) the line where the mucous membrane folds from one surface to another. In some cases, however, it takes an outward course irrespective of these conditions.

I am not aware that alveolar abscess, associated with the superior incisors or canines, ever points upon the surface of the face; the bicuspids, first and second molar, and all the teeth of the lower jaw may produce this form of the disease. In the upper jaw the abscess appears upon the cheek, at a point corresponding with the extremity of the tooth's fang, under the edge of the malar bone; in the lower jaw it forms along the edge of the jaw below the buccinator muscle when the molars or biscupids are its cause; but when associated with the inferior incisors (canines also?), it points frequently beneath, and sometimes in front of, the chin.

When the alveolar abscess is about to point externally, the integument becomes firmly glued down to the bone around the spot where the matter ultimately appears; the area within this space is red, distended, and glistening; the skin becomes thin and papery, and the epidermis scales off. If the surface be kept dry, the breaking of the abscess is often tardy and delayed; but it ultimately bursts through a jagged opening, which soon changes into a small fistulous orifice, surrounded by a pouting circular lip of granulations, that sink into a depression, surrounded by the adhesions which limit the pus-discharging canal. The appearances now are very characteristic, and when once recognized cannot be afterwards mistaken. Sometimes the lip of granulations becomes elongated into a papilla, and is covered with cuticle. I have seen one more than half an inch

in length. The apex of this papilla has an orifice, which is the outlet of the fistulous canal communicating with the abscess. It frequently closes for a time, but bursts again as the matter accumulates. When once this papilla forms, it returns again and again, after excision by the knife, till the cause of the whole malady (the carious tooth) is removed. Another curious modification of the external orifice of the alveolar abscess is occasionally seen when it pierces the under surface of the chin; in such cases a *pad* of granulations sometimes forms, as large as the area of one's thumb-nail, from the centre of which the discharge flows.

In children, with the milk-teeth, alveolar abscess very seldom opens on the surface of the face. I have, however, seen a few such cases. On account of the extreme thinness of the alveoli in them, the end of the affected fang frequently appears through the orifice of the discharge within the mouth, and often projects so far as to wound and ulcerate the mucous membrane of the cheek or lip.

It sometimes happens, that after the first evacuation of the pus of an alveolar abscess the secretion becomes serous. I have known some instances in which the sac of the abscess has remained as a serous cyst even after the extraction of the tooth upon which it originally depended, the secretion recurring again and again after the cyst had been lanced. In one instance, where it had happened in a child in connection with an upper incisor tooth, I found it necessary to remove a portion of the wall of the cyst, when it granulated from the interior and was obliterated.

The *diagnosis* of alveolar abscess is really very simple, though, as I have said, it is often mistaken for diseased bone in those examples where the orifice occurs on the surface of the face. The tooth is the equivalent in these cases of a sequestrum; and it is, as far as the pulp-vitality goes, a dead organ. The fistulous canal leads to the dead tooth, as a sinus to the dead bone; thus far the two conditions are alike, and their appearances are alike; but there are obvious differences. [While the death of the pulp must precede this form of alveolar abscess, the vitality of the tooth is not necessarily destroyed, as nutrition is still maintained through the remaining healthy periosteum.] In alveolar abscess there is less general swelling, except at first in acute cases, and there is an absence of the diffuse indurated lymph-infiltration of the cellular tissue, which is present in bone-necrosis; the canal leading to the abscess is single, usually short and direct, and not burrowing and complicated as in bone-disease;[1] moreover, there is generally an absence of fœtor in the discharge. The locality in a doubtful case, being the neighborhood of the jaw, is in favor of the idea of a tooth being the cause; and an appeal to the state of the teeth seldom fails to settle the question definitely. Sometimes, however, a difficulty may arise from the fact that the cause of the abscess is a mere stump, overlapped by prominent gum; or, what occasions still more obscurity, the abscess may consist of a large excavated cavity in the substance of the jaw, into which the stump has fallen and become loose and free. A probe and the elevator will in either case complete the investigation.

While alveolar abscess, when connected with the integument of the face, is very apt to be mistaken by surgeons for diseased bone, the reverse has happened where a dentist has attributed to carious teeth morbid conditions which have been coincident with them, though not produced by them. I have known this occur in an instance where the patient was suffering from scrofulous caries of the malar bone near its suture with the superior maxilla—a mistake which led to the extraction of two slightly damaged teeth in no way connected with the disease. Again, I have seen one of the submaxillary lymphatic glands, rather adherent to the bone and in an early state of suppuration, mistaken for an outward-pointing alveolar abscess. Such errors as these, leading at most to the extraction of carious, though innocent teeth, are trivial in comparison with those more frequent mistakes in which alveolar abscess is confounded with bone-disease, and an easily cured malady is allowed to run its course unrestrained, and permanently disfigure the face.

The *cause* of alveolar abscess is either caries of a tooth or death of the organ; the latter usually the result of mechanical violence, which has separated the pulp from its continuity with the subjacent nervous and vascular structures [and may be traced to any of those injuries the tooth has received, as already mentioned under

[1] I once saw a very remarkable exception to the above, nearly universal, rule. A lady consulted me on account of a burrowing abscess, which first burst immediately below the lower jaw on the right side. This orifice closed and another formed lower down; this also closed, and was followed by another in the neck. The burrowing continued, and when I saw the patient, many months after the first discharge of pus, there were two sinuses opening about an inch *below* the right clavicle. A carious first lower molar had caused the suppuration, and its removal was followed by the immediate healing of the sinuses.

the head of periodontitis]. It is uncommon to see the affection arise in association with sound and apparently uninjured teeth, though this sometimes occurs. [It is very questionable whether entirely uninjured teeth ever are affected in this way.]

The *treatment* of alveolar abscess depends upon the stage at which the case is seen. In the earliest period, when suppuration is rather impending than established, the malady may be cut short by the extraction of the affected tooth, or by the removal of the stopping in a stopped tooth. Often it is undesirable to extract a particular tooth that may be threatening or causing the abscess; and in that case recourse should be had to leeching the gum freely, the administration of brisk purgatives, and abundant hot fomentation of the face at the swelling part. This mode of treatment, when it does not arrest the malady, much mitigates the attendant suffering. When matter has formed, and the wall of the abscess has sufficiently thinned, the pus should be evacuated by a puncture made through the gum with a narrow thin scalpel. This is followed by immediate and complete relief, and the general swelling associated with the advent of the attack rapidly subsides; but the disease, in the very great majority of cases, remains in the form of a continuously pus-discharging fistula. It is very rare indeed for the pus-secretion to cease: it may be so diminished that the external orifice may close for a time, but it is pretty sure to burst out again and again; though I am confident (contrary to the general published opinion) that in a few exceptional instances the disease ceases altogether, the offending tooth still remaining in the mouth.

When an alveolar abscess shows symptoms indicative of external pointing, immediate and active treatment is necessary. The offending tooth should be taken out; and in case it breaks in extracting, every vestige should be sought and removed. If matter has formed, and there has been decided thinning of the integument, showing its near approach to the surface, not only should the tooth be extracted, but a vertical incision should be made between the cheek and the jaw, so as to cut across the pus-containing canal; else the matter is apt to *pocket*, and cause progressive absorption to the surface; and though the tooth be removed, the abscess may thus still open externally. This vertical incision between the cheek and the jaw is also useful after the removal of a tooth, even when the external opening has occurred; it cuts across the bands of lymph which glue the integument down to the bone: in this case a piece of oiled lint should be introduced and kept in the wound, to prevent the adhesion and reunion of the cut surfaces. In all cases of alveolar abscess, extraction of the diseased or dead tooth is *the* cure; and I know but of two circumstances which peremptorily interdict this mode of treatment. First, where a strongly-pronounced hemorrhagic diathesis forbids the extraction of teeth altogether; and secondly, in those cases where the abscess is associated with the upper incisor teeth of young people in whom the jaws have not yet assumed their adult form, and where the permanent dentition is, as yet, incomplete. In this latter case it is of much importance to retain the teeth, even if reduced by decay to mere fangs, till the adult form of the jaws is established, even at great cost of suffering and discomfort. The earlier removal of the teeth would be followed by such contraction of the maxillary arch as would be incompatible with a proper replacement by artificial teeth of the natural ones missing.

[In the earliest period of alveolar abscess there is simply an overcharged condition of the vessels, which, as has been seen, may be changed by proper remedies. As the malady increases and becomes unyielding to all treatment, it passes to a stage where it requires more active effort to overcome it, or it must be left to those natural processes that, in due time, will bring about a restoration to comparative health. The hyperæmic condition increasingly thickens the periosteum, causing an absolute elongation of the tooth, thus aggravating the disease by constant occlusion with opposing teeth. This tendency may remedied by fitting a cap to one or more of the other teeth. It is at this period that the greatest amount of pain is felt. The increased thickening of the membrane, combined with the accumulation of pus, produces pressure on the wall of the alveolus, resulting in absorption of that tissue and an opening for the egress of pus into the soft tissues. The time required for this natural process varies with the tooth affected. It does not usually require more than two days in the superior and inferior incisors and bicuspids; much longer in the canines and molars, especially in the inferior first and second molars. The difference in time is caused by the character of the alveolus in which the teeth are embedded, the one being comparatively thin, and the other thick and dense.

The first consideration in treatment is to eliminate the probable cause. If there be a filling in the tooth affected it should, if possible, be removed, but this is not always possible owing to the extreme pain attendant on any force applied. Drilling through the filling should then be resorted to and effort made to reach the pulp-chamber. If the tooth has a dead pulp,

without caries, the same processes should be adopted. In this case entrance should be made by drill, through the palatine or lingual surfaces of the six anterior or inferior teeth; on the buccal surfaces of the other teeth. The object of this is to afford a vent for the pus that very frequently has found its way through the foramen into the canal. When this simple operation is successful, it affords relief in a very short time. If the disease be in one of the four superior incisors, and on failure to evacuate the pus by drilling into the crown, the operation should be continued through the foramen. This can be accomplished by a small drill or by a broach. If it is thoroughly done, no further trouble need be anticipated. If this, however, fails, as it will frequently, owing to the extreme nervousness of patients, a quicker and better plan should be resorted to, if the abscess be in the anterior teeth, upper or under. An opening should be made as nearly opposite the apex of the root as possible. In making this, care should be taken to measure the probable length of the root. The protuberance of the alveolus over the root will be a tolerably sure guide, but generally the anatomical knowledge of the parts can alone be relied upon. The operation is a very simple though painful one, and care must be exercised that no mistake is made in the location of the puncture. The intention should be to penetrate the sac, and it, therefore, must be made as near to that as possible. The most effectual instrument for this purpose is the ordinary dental drill used by hand. The dental engine is not needed here, or is it advisable. A few turns of the instrument are quite sufficient to penetrate the gum and alveolus. If the entrance has been properly made, pus will follow the withdrawal of the instrument, and relief will speedily be obtained. A tent of cotton should be inserted in the gum to keep it open. This operation cannot be performed satisfactorily on the molars, owing to their peculiar implantation. If from this or any other cause it be found inadmissible, natural processes can then only be depended on, and, as before remarked, these require a tedious time of suffering to the patient.

Much benefit can be derived from efforts properly directed to hasten this process. For this purpose, hot applications should be resorted to in the mouth and over the tooth affected, and not, as frequently recommended, on the face. Hot fomentations should never be applied there, for the obvious reason that their action tends to external pointing. There has never been anything more effectual found for the retention of heat at the point desired, than a fig divided and roasted, or raisins similarly treated.

As soon as it is evident that the pus has made its way through the alveolus, the diagnostic sign of which is the subsidence of the acute pain, an incision should be made in the soft tissue, extended to the point of pulsation. This can readily be decided by the finger.

The discharge of the pus is followed, ordinarily in a few hours, by a comparative state of health, and all the parts seem to resume a normal state. This, however, is only apparent and not real, for a tooth once attacked by abscess in its periosteum, its most vital part, can never be regarded as a healthy tooth. The abscess terminates by the destruction of the membrane at the extremity, and the apex assumes the character of necrosed bone, resorption takes place, and while its irritating properties may remain dormant and the tooth be made a useful member of the series, it is so far an imperfect member.

The secretion of the pus may cease with its discharge, or it may continue and assume a chronic form, or it may remain dormant to be renewed at varying intervals. These repetitions are rarely accompanied with much pain or swelling, owing to the fact that absorption of the hard tissue was accomplished in the first instance, and the pus has only to channel a way through the soft tissue. In the chronic form a fistula is established, producing an enlargement on the gum over the tooth, familiarly known as a "gum-boil."

Treatment to secure comparative health must be aimed to rouse the parts immediately adjacent to healthy action. Two avenues of access exist to effect this: one through the root of the affected tooth, and the other through the fistula. The former is the preferable mode. The canal must be enlarged, and a free opening made through the foramen. Various escharotics have been used for the purpose of exciting healthy granulations; but the best, and when thoroughly used, the most effectual, is carbolic acid in reduced strength.

The injection may be effected in one of two ways, either of which may be made available as circumstances will admit. The simplest is to make a piston of a drill by wrapping it with cotton; and after saturating it with the agent to be used, insert it in the canal and pump the fluid through the tooth to the part affected. If there is no obstruction in the way, the evidence of complete saturation of the parts will be manifested by the eschar on the surface of the gum at the opening of the fistula. Where this has been effectual, no further treatment will be required for ten days. A more efficient mode of injection is accomplished by the syringe, a modification of the hypodermic, made by Dr. Farrar. This is

the only mode that can be satisfactorily used where it is desired to make the injection through the fistula. Before this is attempted the opening should be enlarged; and an effort has been sometimes made to cut away the diseased tissue by the use of the dental engine and properly-constructed burs. It is questionable whether this operation is of any advantage. When attempted it should be thoroughly done, and the parts well syringed out with warm water.

No attempt at restoration will have any permanent value unless the root or roots are thoroughly filled; and this should not be tried until the best condition obtainable is secured.

In the chronic form, where the flow of pus is constant, it is evident that systemic conditions operate against a cure; then extraction is the best and only remedy; but under no other circumstances should this be resorted to.

Pyorrhœa alveolaris. — Inflammation of the periodonteum, commencing at the necks of one or more of the teeth, very slowly, but surely, destroys the membrane and ends in the destruction of the tooth. It assumes different forms: in some cases the inflammatory zone is so circumscribed that the disease progresses with extreme slowness, and causes no special uneasiness. In other cases the destruction of the periosteum and denudation of the cemental tissue produces a continuous and oftentimes very severe pain, intermitting in character. In other cases it assumes serious proportions, and may extend so as to involve all the teeth. The periosteum rapidly succumbs, followed by a necrosed condition of the alveolus at that part. At times pus will exude; at others its presence will only be indicated by pressure upon the gum. To this condition the French writers have given the name of pyorrhœa alveolaris. In this country it has been termed "Riggs's disease." It is simply a chronic form of abscess, modified by location, and extended by continued local irritation. The origin of this trouble may be found in any cause of irritation at the margin of the gum, and will be aggravated in persons of cachectic condition. The primary causes are a deposition of salivary calculi, which, by a gradual pressure, destroys the soft tissues and creates a pocket for the retention of foreign matter, and thus the disease, once started, continues indefinitely. The excessive use of hard tooth-picks between the teeth has the same result. The use of hard brushes at the margin of the gums is very injurious. Teeth of extreme density, in which the tubuli have been obliterated, are fit subjects for this destructive influence, as they are manifestly foreign bodies and incapable of receiving nutrition through the periodonteum. Consequently this disease is found in some one of its forms in elderly persons. False teeth, by unequal pressure upon healthy teeth, often produce the same effect; but the worst results are to be looked for in persons of a depraved habit of body and great uncleanliness.

Microscopic examination of the exuded fluid shows it to consist principally of pus globules, and an unusually large number of bacteria. The numbers of the latter justify the inference that they have largely to do with the inflammation in its most aggravated forms.

The *treatment* has not, until recent years, been attended with very satisfactory results. Dr. Riggs, of Hartford, first called attention to the possibility of treating this by a surgical operation; and for this purpose he devised several forms of knives or scalers to reach all parts of the roots. Thus by removing all the necrosed portions and any particles of tartar present, better results have been attained than heretofore. After thoroughly removing all dead particles and foreign matter, syringe the parts with tepid water and then apply aromatic sulphuric acid in greatly reduced strength, or a ten per cent. solution of ordinary acid. This is best applied through the Farrar syringe, but it can be quite effectually accomplished by a piece of soft wood sharpened flat and wrapped with a thin cover of cotton. This can be made to reach all parts; and this must be done to have any good results. This treatment destroys all germs of disease, dissolves any remnants of necrosed bone or tartar, and rouses the dormant powers to healthy action. The teeth, before this is applied, should be well polished.

This treatment should be followed by the use of a mouth wash. The simplest and best will, probably, be found in the following:—

℞. Thymol, gr. xvj
Alcoholis, f℥iij. M.

The patient should be directed to take four or five drops of the above to a tumbler of water, and use daily with the brush, as a wash.

While this treatment is effectual in the majority of cases having a local origin, it will not be so successful in those complicated with systemic conditions. Here local, combined with general treatment, is indicated. If these fail, extraction is the final and best remedy in all teeth implicated.]

II. *Painful and difficult eruption of wisdom-teeth.*—The advent of the wisdom-teeth is very often accompanied by painful and distressing symptoms, that may be

protracted through many months, or even years, unless relieved by surgical interference. These circumstances arise from the position occupied by the wisdom-teeth, so close to the joint of the lower jaw, where the mucous membrane is reflected from the gum to the cheek and fauces, combined with the very common condition —that the jaw is not sufficiently elongated backwards to allow the dentes sapientiæ to range in the horizontal series with the other teeth. This mechanical difficulty not only prevents the proper evolution of the wisdom-teeth, holding them back in their bony bed, but it often perverts their direction of growth and dislocates them. Annoying and very painful as are often the symptoms attendant on difficult cutting and misplacement of the upper wisdom-teeth, they are trivial in comparison with those which occur in similar conditions of the lower.

The ordinary misplacement of the upper wise teeth is either backwards or outwards, or in both directions combined. When the tooth points backwards, every time the mouth is closed its crown comes in contact with the mucous membrane, passing up on the base of the coronoid process; when the direction is outwards, which is more common, the tooth projects into the cheek, and when the jaws are brought together, a portion of the mucous membrane in this region is nipped and pinched. This is a very painful affair: the surface becomes ulcerated and extremely tender; there is a partial cicatrization, and the structure becomes stiff and hard as well as painful. Beyond this, however, the symptoms never (as I believe) extend, and the removal of the offending tooth is always followed by complete and immediate relief.

The difficulty which most commonly occurs with the inferior dens sapientiæ is attributable to insufficient room in the jaw: the tooth grows normally in direction and in position as regards its neighbor in front, but, from an imperfect lengthening of the horizontal ramus of the jaw, the birth of the crown is only partial and incomplete: the tooth is upright, but only its front cusps emerge, while the hinder cusps are still covered in with gum, or even the upper wall of the bony loculus in which it was formed. This produces a terrible pinching of the mucous membrane over the tooth every time the jaws are brought together. Before, however, the enamel eminences of the tooth's crown make their appearance, the soft structures behind the second molar become much inflamed, and often suppurate, the pus-secretion appearing to be within the enamel sac of the tooth, between the tooth-crown and the membrane covering it. The inflammation, to which this impaction and pressure give rise, extends to surrounding tissues: the cheek and the fauces suffer; the movements of the jaw become stiff and painful; and deglutition is difficult, and attended with suffering like "sore-throat."

[It frequently occurs that the development of the superior third molar is far in advance of the inferior, causing the superior to impinge on the crown of the latter before it has emerged above the free margin of the gum. The result is a retarding of the eruption, and the inferior tooth remains impacted and partially covered with gum-tissue, which is constantly irritated by the superior tooth. There is but one remedy for this, and that is in the extraction of one or the other; which one, will depend on the condition and character.]

Next in frequency to the foregoing malposition is that in which the wisdom-tooth is developed horizontally forwards, more or less. It is attended often with serious consequences. This direction is sometimes combined with an inward leaning; and very rarely the crown of the tooth points outwards. This latter dislocation is very unusual; but the most severe case of suffering from misplacement of the lower wisdom-tooth which I have ever seen was of this variety.

[The importance of attention to this form of impaction of the wisdom-teeth cannot be overestimated. It is the cause of some of the most serious lesions, ending, in recorded cases, in insanity and death. The position of this tooth, lying horizontally, deeply imbedded in the alveolus, and entirely out of sight, causes it in most cases to be overlooked in the diagnosis of neuralgia. With a tooth thus abnormally placed there will be, in the earlier stages, no disturbance. This will be first manifested when development has progressed to the completion of the roots. Inpingement of the crown upon the posterior root of the second molar prevents any advance in that direction, and, therefore, growth must necessarily proceed obliquely towards the coronoid process. There can be but one result with such a condition, and that is, pressure, first on the nerves of the pulp at the apex, and secondly, upon some one of the larger branches. The natural result is a continuous increase of pain, which, fortunately for the sufferer, has periods of cessation.

One of many such cases illustrates the severity of this form of malposition. The lady was sent by a prominent physician, who, in his note of introduction, stated that she was "suffering with a most unmanageable neuralgia." On inquiry it was noticed that she had been a sufferer for *twenty-one years*, the severe pains first

noticed about the age of eighteen. She exhibited great nervous prostration, together with a loss of hearing, partial paralysis of the muscles of the eye, and impaired vision. The diagnosis developed nothing in the teeth, *in situ*, as the cause; but the absence of the third molar, and slight periostitis indicated in the second, led to the conclusion that the wisdom-tooth was lying horizontally and pressing against this tooth. Examination proved this to be the case. The extraction of the second molar was at once decided upon, and upon its removal there was immediate relief. The patient was seen a month subsequently, and had had no return of pain. Her hearing was greatly improved, and there was every prospect of a general re-establishment of normal conditions. It is evident from this that the period from eighteen to twenty-four is an important one, and one in which these teeth should be carefully observed. In this case a life was wrecked by careless diagnosis.]

There is one peculiar symptom frequently associated with the painful cutting of a lower wisdom-tooth, which adds to the difficulty of investigating the condition of the parts, and still more interferes with the treatment: this symptom is *spasmodic contraction of the masseter muscle*, of a continuous and persistent character, the result of contiguous irritation; not a spasm which varies in intensity, but a true *tonic* spasm, the muscles being permanently *set*, so as to keep the jaws nearly closed, and susceptible only of very slight separation. The jaw can usually be opened to a small extent, and then is definitely fixed; it feels as if there were a mechanical obstacle to further movement; but it is not so; for when the cause of irritation is removed, the spasm rapidly ceases, and then the mouth can be fully opened. This same form of spasm sometimes occurs from caries of the molars, irrespective of crowding. The pain that accompanies and precedes the cutting of a wisdom-tooth varies very much in different individuals; but it is frequently of a dull aching character like rheumatism, for which it is occasionally mistaken; it is diffuse and erratic, extending up the side of the head, and down to the shoulder. There is not unfrequently a good deal of swelling of the soft parts in the neighborhood of the tooth, and this sometimes extends to the cheek and to the eyelids even, and below the angle of the jaw: the lymphatic glands beneath the jaw also occasionally become enlarged and tender.

The most distressing result, however, that occurs in these cases is the suppuration which sometimes attends the difficult eruption of the tooth. In slight cases, even where there is no misplacement or want of room, but simply a restrained progress, from an unusually dense or cartilaginous overlying gum, pus will be occasionally formed; being secreted (as it has seemed to me) within the capsule of the tooth, by that which was the "enamel pulp." In severer cases, the pus burrows among the areolar tissue, around the periosteum of the jaw; the neighboring soft structures become infiltrated with lymph, and the integument is glued irregularly to the bone; pus points at different spots, often remote from its original source; and the whole cheek may be undermined with a series of sinuses. I have seen the side of the face, from the tragus of the ear and the angle of the jaw behind, to the angle of the mouth and mental foramen in front, a web of pus-discharging fistulæ, and which, after their cure (by the mere removal of an impacted wisdom-tooth), left the integument thin, and bound down to the bone, with the glossy, tense, cicatrix-like aspect of a recently-healed burn—a great and permanent disfigurement. While such cases are in activity, they have very much the appearance of necrosed bone. And, indeed, they do occasionally lead to necrosis of more or less of the jaw; but the severest suffering and most suspicious symptoms may occur without such a complication. What is the precise anatomical condition of these burrowing suppurations I am not prepared to say positively. They are not apparently connected with the fang of the wisdom-tooth, like an alveolar abscess. I believe they commence in the enamel sac, before any portion of the crown pierces the gum; and their subsequent course of burrowing is from the matter *pocketing* in a downward and onward progress. As long as any part of the crown of the tooth is covered by gum, pus will be secreted by the under surface of the overlying portion. I have seen an impacted wisdom-tooth give rise to that form of serous cyst known as a "dentigerous cyst." In those instances where the crown of the wisdom-tooth projects forwards, the second molar very often suffers. The posterior fang is apt to be eroded by absorption, and the whole tooth may become necrosed; the first of these conditions is very common: I have met with several instances of it; in four specimens of lower second molars now before me, which were removed on account of forward pressure of wisdom-teeth, the posterior fangs are excavated by absorption in all; in two the pulp-cavity is closely approached; in two it is opened, and in one of the latter there was total necrosis of the whole tooth; the periosteum was completely stripped from both fangs, which were unattached in their

sockets, and bathed in pus. These affections of the second molar should be taken into consideration in balancing the merits of the plans of treatment which may be contemplated in any particular case, and will, I think, favor that course of proceeding which I believe ought in many instances to be followed, but which is not usually adopted.

Treatment.—The wisdom-tooth of the upper jaw, when misplaced, suggests but one mode of treatment; it by far the most often projects outwards; it is then useless for mastication; and if it pinches the cheek painfully on closing the mouth, it may be removed unhesitatingly and without compunction. The same may be said when it grows backwards and bruises the mucous membrane over the base of the coronoid process: the tooth is useless, and worse than useless, and should be extracted; it is very readily done, and, as far as I know, the annoyances attendant on the misplacement of the upper wisdom-tooth are never attended with that locked-jaw complication which so frequently attends the difficulties of the lower third molar eruption. In one rare instance, in which the upper wisdom-tooth grew forwards, it was found necessary to extract the second molar, on account of damage which it had occasioned by producing absorption of the neck of the anterior tooth.

In the treatment of these cases in the lower jaw, much will depend on the degree of impaction of the tooth; if it is simply covered over by a dense and cartilaginous gum, free lancing is all that may be required; but it will often have to be repeated. In young precocious people, who arrive very early at puberty, the wisdom-teeth often make their appearance before the jaw is ready for their reception, and are embedded in the base of the coronoid process, though in a proper upright position. The age of the patient in such a condition is an important question: if young, lancing the gum freely, and waiting for further elongation of the jaw, and more horizontal accommodation, may be fairly and reasonably adopted; but the same state of things in an older patient is not so likely to find this relief; and if the suffering of the patient is great, extraction of the impacted tooth will become necessary. Where the tooth emerges tardily, and where the anterior cusps have come through the gum while the posterior have remained covered, I have found great advantage not only in lancing, but in cutting away the gum which overlies the back of the tooth, so as to lay bare the whole of the masticating surface of the crown. Merely lancing the gum affords much less relief, and the cut surfaces are apt to unite, and then present a harder and more resisting impediment. If the impaction is severe, and there is no chance, from the age of the patient, of sufficient accommodation, it will be necessary to extract a tooth, so as to relieve the crushing tension; and the question now arises as to which of the two, the second or third molar, should be extracted. *Cæteris paribus*, it is always better to sacrifice the third than the second molar: the wisdom-tooth is less useful for mastication, and is more liable to decay; it is altogether less robust: but the circumstances of the two teeth may not be equal or parallel—the second molar may be carious, or it may be loose or necrosed by the pressure of the tooth behind it: in either case I prefer extracting it to the wisdom-tooth. Again, the wisdom-tooth may be so situated that its extraction may be a physical impossibility, or nearly so, as is frequently the case where it grows horizontally forwards, deep down in the jaw. Another reason, the rigidity of the masseter spasm, may render it impossible to reach the tooth. In either case I should extract the second molar, though perfectly sound, without hesitation. The distressing symptoms which are peculiar to the difficult eruption of the *lower* wisdom-tooth—the heavy pain, the sense of *tension* and *pressure*—are clearly dependent on the antagonism of the third and second molars; the former pushing forward into place, and the latter resisting its progress. The removal of the second molar puts an end to this antagonism as completely as that of the wisdom-tooth; and, in result, the one operation gives as entire and immediate relief as the other. When the second molar is extracted, the wisdom-tooth comes forward wonderfully; and an oblique or nearly horizontal tooth will advance in position, and alter in attitude, so as to become nearly, or quite, vertical, and a fair opponent to the upper second molar. In this improved position, when it can be used habitually in mastication, the dens sapientiæ is less liable to caries. But when suppuration has become established, every effort should be made to remove the wisdom-tooth itself, as the extraction of the second molar, under these circumstances, generally fails to arrest the discharge of pus.

The closure of the jaws is often so complete that, until this condition has been combated, it is impossible to get at either of the molar teeth. By pressing apart the jaws with some sort of wedge, this may be accomplished gradually, and in two or three days sufficiently to allow the removal of the tooth selected for extraction. Steel instruments have been devised on the principle of an ear-speculum, composed of two shafts or blades, which separate slowly, but forcibly, by the action

of a screw. I prefer a wedge of hard wood, such as beech- or box-wood, which is pushed further and further into the mouth, as the contracted masseter yields before it. It seems to obliterate the spasmodic contraction for so much at each further introduction, and in a few days such an instrument will open the mouth sufficiently for tooth-extraction. Another arrangement, however, invented by Mr. Maunder of the London Hospital, seems to possess advantages over those previously in use. It consists of a cone of box-wood or ivory, upon which is put a spiral screw-worm, gradually increasing in diameter and in thickness of the worm: it resembles the shell of a univalve mollusc, such as a whelk-shell, only the spire is more elongated and drawn out. In cases where closure of the mouth is brought about by spasm induced through the painful eruption of a wisdom-tooth, occurring as it does in early life, the teeth in the front of the mouth are almost always firm, and would readily bear the wedging force. Upon introducing the point of Mr. Maunder's "gag" between the incisors, or canines, or premolars, and slowly turning the instrument, it evenly and in regular progress separates the jaws, and, as I have thought, with quicker results than any other method. [Pressure is a very tedious and often a very unsatisfactory method to overcome this contraction. Much better results can at times be obtained by the use of the galvanic current; in one case relieving the rigidity, of two weeks' standing, in half an hour.]

In extracting an impacted wisdom-tooth one accident will occasionally arise; namely, the crushing of the inferior maxillary nerve beneath the tooth-fang. It is immediately attended by loss of feeling in the teeth and lower lip of that side. This has occurred twice to myself. In each case sensation slowly returned, and was quite re-established in a few weeks.

III. *Tumors of the gum.*—(*a*) Epulis: (*b*) Congenital hypertrophy of the gum and alveolar borders of the maxillæ: (*c*) Polypus of the gum: (*d*) Vascular tumors: (*e*) Warty tumors of the gum.

Epulis.—"The term 'epulis' has been vaguely applied to various tumors that are found in and beneath the gums. The etymological meaning of the word (*ἐπί, upon, οὖλα, the gums*), entirely referring to position, and not to structure, is likely to have caused and to continue this confusion. Where, however, distinction has been drawn, it has been applied to those hard and densely fibrous tumors that arise from the surface of the alveolar processes, involving the periosteum, and by their expanded growth stretching the otherwise healthy gum over them. These are essentially different in origin, history, and anatomical structure, from the loose flaps, and often pedunculated masses of gum, mere hypertrophied integument, that are not unfrequently seen in the neighborhood of decayed teeth, and to which the designations 'polypus' and 'fungus' of the gum have been appropriately given."[1]

An epulis tumor consists of a hard dense mass growing slowly and evenly from the edge of the alveolar process, usually between two standing teeth, and more commonly on the labial or buccal aspect than the lingual. The point at which this growth generally makes its appearance is beneath and involving the little tongue of gum which exists between the necks of two contiguous teeth; as it progresses in size, it displaces the neighboring teeth, one usually more than the other: it has for the most part a broad base, and increases in basal area more than in projecting growth. The situation in which an epulis commences is liable to a good deal of variety: though usually at the free edge of the alveolar process, it may form at a distance from it; but I believe it is always associated with porous vascular bone, nearly connected with the periodontal membrane, and does not spring from the compact tissue limiting the outline of the bone. The growth sometimes commences *in* the tooth-socket. As I have remarked, the *endosteal* membrane shares in the genesis of an epulis tumor, and the fibrous growth appears to burrow, so to speak, into the substance of the bone, producing a general expansion of the whole structure. The surface of the tumor is like that of the surrounding gum; it is, however, sometimes mottled, and not infrequently slightly but broadly and flatly lobulated. It is as insensitive as the surrounding gum, and is not liable to bleed; when manipulated, it is tense and elastic. The tumor varies in size indefinitely—from the size of a pea to that of a walnut, or larger. It is generally stated that epulis tumors are more common in the upper than the lower jaw: this coincides with my own experience. I happen to have met with them in the proportion exactly of two of the former to one of the latter. The epulis tumor appears to have a certain relation to the teeth in whose neighborhood it forms. It almost always makes its appearance where there *are* teeth: it usually invades one in a very marked degree more than any other near which it may be situated, by dislocating it and pushing it out of place; it has

[1] "Specimens of Epulis," by S. J. A. Salter, Trans. Path. Soc., vol. v., 1854.

nothing to do apparently with caries of the tooth: the removal of the particular tooth, with excision of the tumor, is almost always accompanied by immediate and complete cure of the disease.

Occasionally these tumors appear where teeth have been removed and the gum seems to be edentulous: it will, however, generally be found in these instances that a fang of one of these teeth has been left behind, and is associated with the irritation that has caused the morbid growth. One of the most severe examples of this malady which I have seen, consisted of a bilobular mass, the size of a large walnut, extending, on the left side of the lower jaw, from the dens sapientiæ to the canine tooth, the four intermediate teeth having been removed. The excision of the tumor had been repeatedly performed, but it always returned. Its removal on this occasion disclosed the remains of one fang of the first molar tooth in its very axis: this was extracted, and the disease did not again make its appearance. I believe this will generally be found the case where the tumor forms upon an apparently edentulous region of the jaw. Epulis has its origin in the osteal membrane of the alveolus. The bone of the alveolar processes is very vascular, and almost cancellated in its loose open structure. The endosteal membrane which lines this cancellated bone, the periosteum which covers it, and which lines the tooth-sockets and the fibrous tissue of the gum, are all continuous, and alike share in the development of the epulis tumor. The bulk of the tumor consists of a dense web of fibrous tissue; and from its basal attachment, and passing into its substance, are usually small growths of bone. The fibrous tissue interlaces pretty regularly — some fibres being parallel to the surface, and others radiating from the base, intersecting the former at right angles. The bone-growths may be thin needle-like spicula, or little flakes: at the point whence these bony processes arise, the tumor receives its main vascular supply, and the subjacent bone is very porous. Mr. Cæsar Hawkins mentions an instance of an epulis attached only by a pedicle to the gum, in which there was a nucleus of bone. This could not at any time have had bony union with the jaw; but the circumstance indicates, in a physiological sense, the osteal character of these fibroid developments. Epulis tumors are perfectly innocent, nor do they, I believe, ever pass into a malignant character. Sometimes, though rarely, they ulcerate on the surface; but this is only under the influence of external agencies, such as produce ulceration of any portion of the gum: they may then become painful.

The histology of epulis tumors is consistent with their history—locally recurrent as long as the circumstances under which they occurred are maintained, destroyed by the removal of their local nidus, and never impregnating the system. Epulis tumors are always, I believe, a form of "fibro-plastic;" a combination of fibrous tissue and myeloid cells, the proportion of the two constituents varying indefinitely. In general, the main bulk of the tumor consists of fibrous tissue; but sometimes the myeloid-cell element preponderates, and may form the major portion of the growth.[1]

The *treatment* of epulis is very simple; it requires early and complete extirpation with the knife, and according to the extent and inveteracy of the case it may also need the removal of contiguous teeth and subjacent bone. These latter circumstances refer to an important circumstance in the *pathological history* of the disease: it is this, that as long as the alveolar process remains upon which the tumor grew, and which must necessarily be as long as the teeth which are implanted in it are not removed, so long will the tumor be inveterate, so often will it return, however accurately and carefully it may have been removed. Such, at least, is the very general rule. But when the alveolar process is gone, it shows no tendency to return. And it is a remarkable circumstance, that the spontaneous absorption of the alveoli that follows the extraction of the teeth is of itself, *in many instances*, where the disease is confined only to these processes, enough to prevent its recurrence. That is to say, if the tumor be removed to a level with the gum, and the contiguous teeth be extracted, the alveolar process vanishes by absorption, and the disease no more returns; though the same operation, without the removal of the teeth, may have been performed unsuccessfully any number of times previously. In a first operation when the disease is of limited extent, it will be well to try the result of its simple removal by the scalpel without the extraction of teeth or the cutting away of more bone than can be accomplished with the knife. The bone about the base and axis of the tumor being vascular and spongy, the knife readily cuts away small portions. Any subsequent sprouting of granulations in an undue or threatening degree should be checked and repressed by some caustic, and for this purpose nitric acid has been especially recommended. If the disease recurs, as it too

[1] "Specimens of Epulis," by S. J. A. Salter, loc. cit.: "Myeloid Epulis of Lower Jaw," by J. Hutchinson, Trans. Path. Soc., vol. viii.

often does, the same operation should be repeated, and accompanied by the extraction of a tooth or teeth whose socket or sockets have been implicated. Unless the disease have a deep hold on the bony substance of the jaw, it will seldom be necessary to cut away any large amount of bone; sometimes, however, this is the case; or the growth may have started deep in the socket of a tooth. In such an instance it may be necessary to extirpate a considerable amount of bone. A V-shaped portion or a cubical mass may be readily cut out by means of a Hey's saw and bone-nippers, according to the form and extent of the particular tumor. It will never, I believe, be necessary to go far below the limit of the alveolar process; for it is with the alveolar bone that the disease is essentially connected. In the lower jaw I would urge the necessity of never cutting through the entire bone, as the breaking of the maxillary arch most seriously interferes with the position of the remaining portions of the bone, and thus disturbs the normal opposition of the teeth in the two jaws relatively.

Congenital hypertrophy of the gum and alveolar borders of the maxillæ.—In 1859 I had an opportunity of seeing a very remarkable example of disease, which is, perhaps, best defined by the above title, under the care of Mr. Pollock, at St. George's Hospital. At that time there was, I believe, no recorded example of this curious tumor-like growth; nor had any instance of it been published, as far as I am aware, until a case was described and figured by Gross in the second edition of his System of Surgery.[1] This case was not only the same in essence, but was singularly like Mr. Pollock's in all particulars.

Two similar cases have since been recorded. One occurred in University College Hospital under the care of Mr. Erichsen, and is described by Mr. Heath.[2] The other is published by Dr. Waterman,[3] an American surgeon.

Mr. Pollock's patient, at the time of her admission into the hospital, was eight years old. At birth nothing was noticed unusual in her mouth, but a fortnight after a tooth was cut, and by the fifth week six had appeared. It was then remarked that the gums were full and thick, and puffy. They continued to increase in bulk, and at two years of age they were cauterized, and all the temporary teeth which had appeared were extracted. At birth the child had an unusual quantity of hair on the head, and also much on the arms and legs; when taken into the hospital, this peculiarity was very striking; the hair of the head was coarse and rank, and grew low on the forehead, and in front of the ears on to the cheeks. The arms and legs were covered with hair. The patient was epileptic.

Before any operation was performed, the girl presented a most extraordinary appearance. A large mass, pink and smooth, protruded from the mouth, which the lips did not and could not cover. It was slightly corrugated or indistinctly lobed; the structure was very dense, inelastic, and insensitive, and appeared skin-like on the surface. The greater bulk proceeded from the upper jaw, and was most developed in the front of the mouth; but the same condition appeared along the whole edge of both jaws, that of the lower jaw being less, and covered and overlapped by the upper.

In structure, this hypertrophied mass consisted both of an expanded and prolonged development of the alveolar borders of the maxillæ, and an immense thickening of the fibrous tissue of the gum, with a proportionately exuberant growth of the papillary surface. The removal of portions of the mass by surgical operation gave opportunities of examining its precise nature. In the front of the upper jaw, where the development was greatest, the fibrous mass extended in some places more than three-quarters of an inch beyond the alveolar edge, which it thus covered in with a dense cushion. Those of the temporary teeth which had not been extracted were deeply embedded in the mass, the crowns of the second lower temporary molars being the only ones which were now visible. The crowns of all four of the six-years-old teeth (first permanent molars) had appeared, on account of the slightness of the hypertrophy towards the back of the mouth. A section of parts of the removed mass displayed the remaining temporary teeth completely clothed with the thick fibrous growth, the fangs embedded in sockets, but the crowns free of bone and each closely surrounded by a serous-like chamber without any communication with the surface. One of the superior central incisors was more deeply covered than any other teeth, and was nearly an inch from the surface. The fangs of the permanent teeth were developed in accordance with the age of the patient; but I observed that the crowns were still encased in the *bony* loculi, though from the age of the patient the distal wall of the bony capsules should, in many of them (incisors and first premolars), have been absorbed. In the socket of the first temporary incisors a small absorbed orifice existed, leading into the loculus of the permanent tooth, such as is usually found about five years old.

But the most remarkable point of structure in this growth was the papillary surface. The epithelium had changed into a very thick and hard epidermis, beneath which, and evenly covered in by it, were enormously

[1] A System of Surgery, etc., by S. D. Gross, M.D. Philadelphia, 1872. 5th edition, vol. ii., p. 504, fig. 372.

[2] Injuries and Diseases of the Jaws, p. 189. London, 1868.

[3] Boston Med. and Surg. Journal, April 8, 1869, p. 167.

long papillæ. The papillæ of gum vary from about $\frac{1}{75}$th to $\frac{1}{35}$th of an inch in length normally; but in a section, vertical to the surface, they here appear from the $\frac{1}{8}$th to the $\frac{1}{4}$th of an inch; and when by maceration the outer epiderm has been removed, the papillæ stand up like the pile of plush or velvet, and may be brushed from side to side by the finger. Kölliker[1] has noticed that in the mouths of edentulous old people, whose bare gums are exposed to the rough attrition of food, the papillæ become much enlarged and elongated, attaining sometimes the $\frac{1}{16}$th of an inch in length; and here, under exposure to still more physical violence, the same change has taken place to a vastly greater degree. But I apprehend that this monstrous development of the papillæ has also another meaning, and that it is an essential element of the disease; it is quite in keeping with the rough and thick skin of the patient, the abundant development of coarse hair over the surface, and also the enormous teeth. The permanent teeth which were removed by the operations are excessively large, especially the superior central incisors; these are larger than any I have before seen removed from a female mouth. All these circumstances imply a tendency to a general tegumentary and papillary hypertrophy.

Treatment.—The proper treatment of this disease is obviously that which was followed in each of the recorded cases. Portions of the projecting mass were cut away with scalpels and bone-nippers till the alveolar borders were curtailed to within moderate limits. The operation was not completed at once, but was performed in detail, as the patients could bear it. In Mr. Pollock's and Dr. Gross's cases there was a slight tendency to a fresh growth where the hypertrophied masses were removed.

Polypus of the gum.—The gum is liable to a simple hypertrophy, the increase of growth—a sort of mucous tubercle—being confined to the gum-structure alone, and not involving the osteal membrane, nor complicated with a growth of bone. The little tongues of gum between the necks of the teeth are liable to this affection, especially towards the front of the mouth; and they sometimes grow to such an extent, being confluent with those on either side, as to cover a considerable portion of the crowns of the teeth. This condition is usually associated with uncleanly habits; and may be generally cured and prevented hereafter by simple and easy means. The teeth should be thoroughly cleansed from tartar; the gums may be scarified: for the future the teeth should be abundantly brushed with a stiff brush, and the mouth washed with an astringent lotion, of which solution of permanganate of potass may form an ingredient. I have seen a modification of this condition, which was evidently syphilitic; the growths of the gum were *condylomatous*, and were more or less covered with very painful superficial ulcers. The symptoms readily yielded to the internal administration of iodide of potassium, and the application with a camel's-hair brush of a solution of nitrate of silver, 10 grs. to ℥j aquæ. Hypertrophy of the gum of a truly polypus-like form not infrequently occurs in the immediate neighborhood of teeth which are carious at their sides, and when the caries reaches the neck of the tooth: the irritation of the contiguous dentinal disease seems to stimulate this unwonted growth, and the mucous membrane bulges into the cavity and fills it up. The cavities of two teeth carious on their contiguous surfaces are very apt to be associated with this condition, the little polypus of gum between them rising to their masticating surfaces. Such tumors are more or less pedunculated; they have a red fleshy look, and are very liable to bleed when roughly touched. The structure of these growths is in consonance with their aspect and the ease with which they bleed; they consist principally of hypertrophy of the true mucous-membrane element of the gum, especially the papillary structure: the epithelial covering is rather diminished in proportional amount, while the papillæ themselves become enormously elongated and increased in diameter, and some of the conical papillæ develop into the compound fungiform variety. These changes are accompanied by great dilatation of the capillaries which loop into the papillæ.

Polypous growths of the gum are so often dependent on the state of the contiguous teeth, that their treatment involves that of the teeth also. If the polypus, growing into a carious tooth, is extirpated, it will most probably return till the tooth itself is removed, or the condition of the tooth which had irritated the gum has been remedied. The caries should be cut away; ragged or sharp edges of tooth-substance should be smoothed and blunted, and the remaining cavity should be filled. The gum may still show some tendency to renewed sprouting, and this may be kept down for a time by the repeated application of a strong solution of nitrate of silver, sulphate of copper, or alum, when it will probably assume a healthy aspect. If the removal of the polypus is accompanied by the extraction of the offending tooth, I believe it never returns.

Vascular tumors.—The tissues about the necks of the teeth are obnoxious to the growth of vascular tumors, which vary from passive *nævus-like* swellings to those other forms of more arterial character—

[1] Mikroskopische Anatomie, etc., von Dr. A. Kölliker, vol. ii., p. 85. Leipsic, 1854.

aneurisms by anastomosis. I have met with both these forms of the disease. The most common position in which it develops itself is in the front of the upper jaw, between the incisors, or canines and lateral incisors. A rather severe instance which occurred recently under my care manifested itself in the region that should have been occupied by the left lateral incisor of the upper jaw; but as the laterals were wanting in this person, the tumor formed between the canine and central incisor. It had been about six months in reaching its then size, the dimensions of a large marble flattened on the surface. It was of a purplish color, streaked with many vessels on the surface; it was easily compressed, but was elastic, and when pressed it became pale, exsanguine, and much reduced in size; upon removing the pressure it resumed its previous aspect in a pulse or two. The surface of the growth was tolerably smooth; the base somewhat constricted, being about one-third less than the head of the tumor. The whole of the gums were very red, turgid, and swollen, and the little tongues of gum between the necks of the teeth generally were enlarged and spongy. The patient had suffered no pain, but was conscious of a constant throbbing and pulsation. The most important symptom, however, was the hemorrhage, which had latterly become a serious source of trouble and distress; it usually occurred at night; it would ooze from the mouth and stain the pillow and sheets, and sometimes trickle into the glottis and cause momentary suffocation.

The treatment which I first adopted in this case was determined by the very *arterial* character of the tumor. I attempted to destroy it by ligature: a needle armed with a double thread was passed through its base, and each portion of the thread was tied so as to strangulate half of its attachment. The ligatures were tied tight, but did not cut through the substance of the growth. Their effect was for the time to produce complete strangulation: the tumor was tense; and the blood could not be squeezed out of it by pressure. This plan did not ultimately succeed, for the size was not permanently diminished, and the circulation was re-established. I next removed the tumor by a very tight ligature, cutting it clean off; after this it returned as before, and I finally extirpated it with a scalpel, cutting freely inwards so as to remove a portion of the spongy vascular bone which seemed to form its basal axis. The bone at the base of these growths appears always to be very vascular and open in its texture. Considerable hemorrhage followed the operation, which ceased under cold and pressure. For a few weeks the cicatrix furnished freely sprouting granulations; these were abundantly cauterized twice a week, and ultimately yielded a healthy scar. In structure this little mass when removed displayed a complicated vascular network, which, under the action of acetic acid, with the microscope, exhibited little else than an elaborate aggregation of the nuclei of bloodvessel muscle-cells. The surface was clotted with epithelium and papillæ, like the gum. I believe that no danger can arise in these cases from the use of the knife in at once extirpating the tumor; the bleeding may be profuse for a minute or two, but it soon ceases.

I have seen a vascular tumor connected apparently with the periosteum of a loose molar tooth, in which the hemorrhage was very severe, occurring also at night to an extent that was really alarming: the tumor was a tense pedunculated mass, attached to the side of an upper molar tooth, half of the fang of which was naked. The extraction of the tooth brought away the tumor with it, which immediately shrivelled up to half its previous volume, and became soft and flabby.[1]

These tumors, as far as I have observed, occur in adult and middle life; they are perfectly innocent, and show no tendency to return when carefully eradicated.

Warty tumors of the gum.—The papillæ of the gum occasionally become hypertrophied into warty growths. A singular instance occurred in the practice of Sir William Fergusson, in which the papillæ were more than half an inch in length: they were soft and shreddy, and consisted mainly of loosely adherent epithelium. The tumor was removed, and recurred several times. Another example was operated on by Mr. Cock, at Guy's Hospital, in which a warty tumor, the size of a split chestnut, formed in the hard palate of a man.[2] This was covered with papillæ the eighth of an inch long. It consisted principally of fibrous tissue and dense coherent epithelium. I have seen a profusion of small warts on the gums associated with warts on the lips and about the face. In all cases the growths should be removed with the knife; and any recurrence should be repressed by caustic or astringent applications.

IV. *Tumors of the pulp.—Polypus of the pulp.*—In carious teeth the tooth-pulp is

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1 "Vascular Tumors connected with the Dental Periosteum," by S. J. A. Salter; Trans. Path. Soc., vol. v., 1854.

2 "Papillary Tumors of the Gum," by S. J. A. Salter, in Guy's Hospital Reports, 3d series, vol. xii., p. 358.

occasionally developed into a polypus-like growth, that fills more or less the diseased cavity. This formation is a dense, gristly, pink-colored mass, consisting of a modification of the original dentine-forming organ: it is always attached by a constricted base to the pulp in the canal of one or more of the fangs; the mass itself is usually more or less rounded, frequently corresponding in form exactly to the carious cavity which contains it; sometimes, by a more exuberant growth, it is forced into a polyhedral shape by the contiguous structures, whose pressure curtails its further enlargement — the masticating surface of the opposing tooth in the other jaw, the distal and proximal neighbors of the tooth from which it has sprung, the tongue and the cheek; such cases as these usually occurring where the walls of the original tooth have completely broken away, leaving a distinct interval bounded by the parts I have named. In such examples it may be difficult to an inexperienced observer to make out the nature of the tumor; it may be mistaken for an *epulis*, or a gum polypus; search for the remains of the decayed tooth will settle this doubt. This polypus is very callous and insensitive to pain; it is not liable to ulcerate or bleed; but it discharges pus from its surface, especially when in contact with the walls of the carious tooth in whose cavity it forms. In structure these polypi approach, in the majority of instances, very closely to the ordinary granulations of a healing sore, consisting superficially of a mass of exudation-corpuscles, through which are distributed multitudes of capillary loops, and more deeply of a fibrous tissue into which these cells have developed. In these instances the more superficial cells appear to be shed, assuming the form and aspect of pus. Rarely these granulations seem to heal, to cicatrize; and I have found a few instances in which the surface of the polypus has been clothed with a dense cuticular epithelium overlying a basement-membrane folded into true papillæ. Polypus of the tooth-pulp "most often occurs in young people, and in those in whom the teeth are imperfectly calcified, presenting that peculiar globular calcification in which the substance of the dentine becomes rapidly sodden with saliva, and carious without limit from the enamel to the pulp." "The physiological phenomena displayed by polypus of the pulp are very remarkable as regards both the pulp itself and the tooth—their oppositeness to the whole train of circumstances which accompany the ordinary inflammation of the pulp dependent on caries, odontalgia, lymph-deposit on fangs, alveolar abscess, etc. . . . . The pulp never undergoes intrinsic calcification, nor have we any evidence that dentine of repair is ever formed."[1] Occasionally, though very rarely, teeth with polypus of the pulp produce alveolar abscess.

The treatment of this condition is very simple. If the polypus is cut away, it will certainly return; caustics and the like applications appear to have no influence in repressing it. If the tooth be extracted, it is finally eradicated; and this plan should always be adopted.

Sensitive growth of pulp after fracture.—This condition only occurs, as I believe, when a tooth with a healthy pulp is suddenly fractured by mechanical violence. When a pulp is thus exposed, it exhibits intense sensitiveness to touch, to cold or heat, or indeed to any external influence; and it frequently sprouts into a small excrescence. This excrescence is usually of a semi-transparent aspect; it is often complicated on the surface, and villus-like: when removed, like the other form of pulp-growth, it certainly returns, and of the same character as before. In microscopic structure this sprouting of the pulp differs little from the insensitive polypus; but its vitality implies a more abundant nervous supply—vascular granulations appear to the observer to constitute its histological elements. This condition remains as a permanent torture to the patient, till the tooth is extracted, when it is of course completely removed. I have known this state of tooth-pulp form a very distressing complication in a case of fracture of the lower jaw, in which a bicuspid tooth was broken and the pulp exposed: here the apparatus for fixing the displaced bone, and the introduction into the mouth of food, were attended with agonizing pain, which continued till its source, a fractured tooth with a quick pulp, was discovered and extracted. Afterwards the treatment of this fracture was successfully and painlessly prosecuted. The possibility, indeed occasionally probability, of such a complication, in treating fractures of the maxillæ, should be borne in mind by surgeons; and it should be especially remembered, that when extreme sensitiveness and pain manifest themselves in such cases, a fractured tooth should be sought for.

V. *Tooth-tumors—Odontomes.*—The hard tissues of teeth are sometimes developed into tumors, which may be divided as follows:—

(*a*) Enamel nodules, or submerged cusps on tooth-fangs.

(*b*) Exostosis.

[1] "Polypus of Tooth-pulp," by S. J. A. Salter, Guy's Hospital Reports, 3d series, vol. iv., 1858.

(c) Hypertrophied, dilated fangs.
(d) Dentine excrescence.
(e) Warty teeth.

Enamel nodules are sometimes seen on the fangs of teeth, forming little pearl-like tumors: they are essentially *submerged cusps*, each consisting of a little cone of dentine, covered by a thick tubercle of enamel, which is clothed by a true enamel pulp.[1] These tumors are not known to occasion any symptoms; and are rather of physiological than surgical interest: indeed they are alluded to here simply to complete the list of tooth-tumors.

The accompanying illustration (fig. 369), is taken from a characteristic specimen.

Fig. 369.

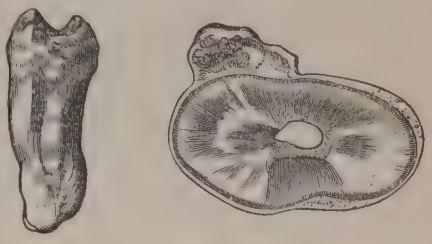
Enamel-nodule on a molar tooth.

Exostosis on the fangs of teeth is sometimes a serious malady. An increased development of crusta petrosa may occur upon the fang of a tooth as the secondary result of other disease in the tooth —usually caries; or it may arise spontaneously—the tooth being entirely free from other abnormal change.

In the former case the thickening of the fang is usually general, around its circumference and principally on its lower third, as represented in fig. 370. The symptoms of this condition are scarcely to be distinguished or separated from those of the tooth-disease with which it is associated.

Where the disease arises spontaneously it is apt to produce the most distressing neuralgic affections. The teeth appear sound, but they become sensitive to change of temperature and even to the touch: they elongate from the sockets and spread; with this there is more or less neuralgia of the trigeminus, or of one of its terminal branches. Then one particular tooth becomes more distinctly affected than the others: all the pain seems to emanate from it: and each flash of neuralgic agony seems to start from it alone. At length the tooth is extracted and relief follows. Then usually another tooth becomes affected and requires removal: and this may, in very severe cases, go on till all the teeth in one jaw, or even in both, have been extracted before complete and permanent relief is obtained.[1] In these cases the exostosis usually consists of small nodules with rounded surfaces situated near the apex of the fang. Such forms of exostosis may, however, exist without producing any apparent symptoms whatever. Fig. 371 represents a magnified section of the fang of a tooth in which this nodular form of exostosis existed.

Fig. 370. Fig. 371.



Exostoses of fang.

Exostosis on the fangs of teeth consists solely of an hypertrophy of the crusta petrosa, or tooth-bone, the outer layer of the fang. It is usually solid and compact in structure: though very rarely it is cancellated and vascular.[2]

Hypertrophied, dilated fangs.—This title best defines the nature of a very rare form of tooth-tumor, of which I believe there are only four recorded examples. [These examples are by no means so rare; a number of specimens are in the museums of the dental colleges in this country.] One of these occurred in the practice of M. Maisonneuve, and is described by M. Forget;[3] another occurred to Mr. Hare, of Limerick, and is described by Mr. Tomes;[4] another is described by Heider and Wedl;[5] and a fourth is a specimen in the Museum of the College of Surgeons of England (Preparation 1022) which has been histologically examined and described by myself.[6] The

[1] For the structure of these growths, see "On Two Forms of Tooth-tumors," by S. J. A. Salter, in Guy's Hospital Reports, 3d series, vol. xiv.,1869.

[1] See a striking case illustrative of this condition, published by the author, in Guy's Hospital Reports, 3d series, vol. xiii., p. 86, 1867.

[2] "Vascular Exostosis," by S. J. A. Salter, in Path. Trans., vol. vi., p. 168. Pl. viii., figs. 3 and 4, 1855.

[3] Des Anomalies dentaires, et de leur influence sur la production des maladies des Os maxillaires, par M. Forget. Paris, 1869. Obs. iii., p. 27, Pl. ii., figs. 1 and 2.

[4] Transactions of Odontological Society of Great Britain, vol. iii., p. 335, 1863.

[5] Atlas zur Pathologie der Zähne, bearbeitet von weil. Prof. Dr. M. Heider und Prof. Dr. C. Wedl, p. 3, fig. 28. Leipzig, Nov., 1868.

[6] Guy's Hospital Reports, 3d series, vol. xiv., p. 463, 1869.

latter is supposed to have been in the collection of John Hunter. The first two of these examples were mistaken for exostoses.

These tumors consist of dilatations of the fangs of the teeth; the dentine-pulp being hypertrophied into a globular mass of considerable size; and when calcified, producing a bone-like mass, generally larger than the tooth itself. In structure these tumors consist of an outer layer of tooth-bone; then a thin shell of true dentine, enclosing the gigantic pulp, which may or may not be calcified. In the former case, this bulky nucleus of the tumor consists of a mass of osteo-dentine.

In the only two cases in which the symptoms were recorded, there was pain with expansion of the jaw at the alveolar portion. In Mr. Hare's case there was a fistulous communication from the tumor through the jaw opening on the cheek. This discharged pus.

In each case the extraction of the tooth brought away the tumor also: the swelling subsided, and the patient recovered completely. Fig. 372 represents the specimen in the Museum of the College of Surgeons.

Fig. 372.

Hypertrophy of fang.

Fig. 373.

Dentine excrescence.

Dentine excrescence.—Nodules of secondary dentine growing from the wall of the pulp-chamber into its cavity, in teeth otherwise apparently healthy, are sometimes seen, though they have not generally been associated (perhaps from imperfect observation) with any definite symptoms. The accompanying illustration (Fig. 373), however, represents an example[1] where the little tumor evidently produced neuralgia, of a character very similar to that occasioned by exostoses on the fangs of teeth. The tooth was a superior central incisor, which was constantly painful: the slightest touch or change in temperature augmented the pain considerably, when it often flashed over the face and nerves of that side of the head with great severity. The extraction of the tooth, which was for the moment attended with a violent paroxysm of neuralgia, completely removed all subsequent pain. The dentine excrescence was the only abnormal condition which the tooth presented. Its pressure upon the nerves of the pulp would readily explain the symptoms of the case.

This anatomical condition is not altogether uncommon, but it seldom causes painful symptoms.

[This abnormal development is very common, a single nodule of secondary dentine oftentimes entirely filling the pulp chamber, and the parenchyma of the pulp being extensively filled with small granules. These are very frequently the cause of severe pain. As this condition is usually found in otherwise healthy teeth, it is rendered very obscure. There are no external indications. It not unfrequently happens that the pulp is nearly or entirely obliterated by this extra development. When this is the case, the process advances without pain. It is only in the granulated form that this is likely to occur. If the tooth, or teeth, for it is frequently found in several, is suspected, there is but one remedy—that of drilling into the pulp and destroying it by the arsenical application. If the unequal pressure be on the nerves in the pulp of the canal this will relieve it; and the tooth can be then treated by the ordinary operation of filling the root or roots. But if this should take place externally in an irregularly exostotic growth, extraction is the only remedy. Such teeth have been successfully reimplanted after excising the growth and treating the tooth; but danger from trismus must not be overlooked.]

Warty teeth.—These are among the rarest and most important of the tooth-tumors. They consist of teeth in which the tissues are hypertrophied and folded into an irregular and complicated mass. The warty condition may affect part of the crown of a tooth; or all the parts of the tooth may be involved; or the irregular mass may consist of teeth blended together.

M. Broca, in a general résumé[1] of this subject, which he read before the Academy of Sciences of Paris (December 30, 1867), divides warty teeth into "circumscribed dentinal odontomes," and "diffuse dentinal odontomes;" the former being those examples in which the warty mass occupies a portion of the tooth only; the latter, in which the whole tooth is implicated,

[1] "Dentine Excrescence within the pulp-cavity of the Incisor Tooth," by S. J. A. Salter, Path. Trans., vol. vi., p. 164, fig. 1, 1855.

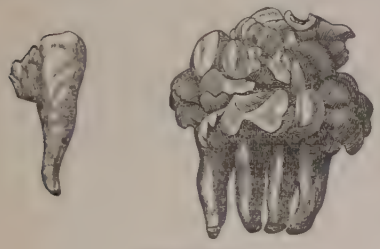
[1] Recherches sur un nouveau Groupe de Tumeurs désigné sous le nom d'Odontomes, par M. P. Broca. Comptes-rendus des Séances de l'Académie des Sciences, tome lxv., p. 1117. Paris, 1867. Also in Gazette médicale de Paris, No. 2, Jan. 11, 1868.

and its anatomical form is no longer recognizable.

Warty teeth are exceedingly rare, and I am only acquainted with twelve recorded examples—six of the circumscribed variety and six of the diffuse. Of the former, four were described by myself,[1] one by Mr. Tomes[2] and one by Forget;[3] of the latter, two were recorded by Oudet[4] (in the same individual), one by Wedl,[5] one by Mr. Tomes,[6] one by Forget,[7] and another by Mr. Harrison.[8]

In the cases recorded by myself, one was a superior lateral incisor with a warty mass, the size of half a horse-bean, projecting from the front of the neck of the tooth. A section of this tooth for the microscope is in my histological collection. A second case, which occurred in my own practice, was that of a right lower dens sapientiæ. The mass, about the size of a small bean, sprouted from the posterior

Fig. 374. Fig. 375.



Warty teeth.

remaining examples are specimens in the Museum of Guy's Hospital: one a lateral incisor, and the other a wise-tooth, both of the upper jaw; from the side of each aspect of the neck of the tooth. My two tooth a warty mass projected. The accompanying illustration (fig. 374), represents the lateral incisor referred to.

Mr. Tomes's specimen was a superior central incisor: the wart occupied the whole of the front of the crown of the tooth. In Forget's example, the first and second lower molars were blended into one: the crowns constituting a large confused wart-like body, while the fangs were normal. This is shown in fig. 375.

The diffuse forms of warty teeth, which have produced large cumbrous tumors, have all been developed in the lower jaw. They deserve more serious consideration.

In Oudet's case a man, twenty-five years of age, exhibited in his lower jaw two hard bony tumors, occupying the premolar region one on each side. They were encrusted with salivary calculus, upon the removal of which, an irregular coating of enamel was displayed, folded into shapes like cusps and tooth-edges. These masses were evidently formed from the fused and hypertrophied germs of the two premolar teeth on both sides of the jaw. The right was removed rather easily by tooth-instruments, but the patient declined to have the other interfered with.

In Wedl's case the whole of the second lower molar tooth of the right side was developed as a large complicated mass in which the several tissues of the teeth were confounded together. It was overlying and keeping down the wisdom-tooth. With a pair of forceps it was removed without much difficulty.

The specimen described by Mr. Tomes is exactly the same as the foregoing. It consisted of a confused mass of dental tissues as large as a chestnut, representing the second lower molar tooth, beneath which was buried the wisdom-tooth. It occurred many years ago in the practice of Sir William Fergusson, who excised the angle of the jaw for its removal.

But M. Forget's is the most serious recorded example of this malformation. Here an enormous tumor, as large as a turkey's egg, occupied the whole of the molar region of the left side of the lower jaw. It represented two molar teeth with their tissues blended together in utter confusion and into a shapeless mass. Beneath it was a third molar tolerably well formed. The jaw began to expand in early childhood, and continued to do so till the patient attained the age of twenty, when M. Forget removed the angle of the jaw, including the tumor. The mass was covered by gum, excepting for a space on its surface the size of a sixpence. There was some pain at times: the submaxillary glands were enlarged, and several fistulous pus-discharging canals led to the base of the tumor. The accompanying illustration (fig. 376) is from Forget's memoir, and displays a section of the tumor *in sitû*.

Mr. Harrison's specimen represented the two bicuspids and canine of the left side on the lower jaw. The tissues were confounded

[1] Description of a Warty Tooth, by S. J. A. Salter, in Trans. Path. Soc., vol. vi., p. 173; London, 1855. "Contributions to Dental Pathology: On Warty Teeth," by S. J. A. Salter, in Guy's Hospital Reports, vol. iv., 3d series; London, 1858. Same title, vol. v., 3d series; London, 1859.

[2] A System of Dental Surgery, by John Tomes, F.R.S., p. 226. London, 1859.

[3] Des Anomalies dentaires et de leur influence sur la production des maladies des Os maxillaires, par M. Forget, p. 25. Paris, 1859.

[4] Cas d'exostoses sur des dents devenues monstrueuses, par M. Oudet, in Nouveau Journal de Médecine, p. 245. Paris, 1821.

[5] Grundzüge der pathologischen Histologie, von Carl Wedl, p. 626. Wien, 1854. A further description of this specimen is published in Heider and Wedl's Atlas zur Pathologie der Zähne, part i., fig. 39.

[6] In Tomes's System of Dental Surgery, p. 225. London, 1859.

[7] Loc. cit., p. 5.

[8] British Journal of Dental Science, vol. v., 557. London, 1862.

together, and without any resemblance to tooth-form. It loosened and came away by itself.

Fig. 376.

Forget's case of warty tooth.

As regards the treatment of these cases, much depends on the degree of the malformation. If it is only partial and a matter of appearance, the tooth may be removed and replaced by a better shaped artificial representative, according to the wishes of the patient. But, should the growth be of large size and interfere with the action of the mouth, it should certainly be extirpated; and this, in nearly all instances, might be accomplished by extraction with forceps; or at all events, without serious damage to the jaw.

VI. "*Abscess*" *of the antrum.* — The term *abscess* of the antrum conveys a very wrong impression of the real nature of this disease; it is not the suppuration of inflamed parenchyma, but the occlusion in a cavity of the purulent secretion from the surface of a mucous membrane which lines that cavity. I need not dwell on the anatomical characters of the antrum maxillare, further than to notice its peculiar relations to those organs, the teeth, whose affections are by far the commonest cause in the production of the malady we are considering. These relations vary extremely, both as regards the extension of the antrum over the fangs of many or few teeth, and the degree in which those fangs approach or pierce the floor of the sinus. It may extend so as to be in immediate relation to all the teeth of the true maxilla from the canine to the dens sapientiæ, or it may be contracted to such narrow limits as only to correspond with two or three of the central ones. This variation in the size of the antrum is not mentioned in text-books of anatomy, but it is pointed out by Otto.[1] Occasionally a root or roots of the first molar tooth (rarely any other) extend into the cavity, free of any bony covering, and merely overlaid by the mucous membrane lining the sinus; more often, however, the palatine and external roots diverge so as to leave an interval between which the more depending sulcus of the antrum is excavated. Another circumstance in the anatomy of the antrum bearing on the purulent accumulation which constitutes abscess of this sinus, is the very variable size of the orifice which opens into the middle meatus of the nose. In some instances the aperture is barely sufficient to admit the blunt point of a probe; in others it would allow the passage of the end of the little finger. It is always much smaller in the living state, when the mucous membrane lines and fills up the opening; indeed, it is the pouting of the tumid mucous membrane which closes the orifice in inflammation. The lining membrane of the antrum is liable, like all other mucous membranes, especially the Schneiderian membrane, of which it is a continuation, to inflammation and altered secretion, mucus being impregnated with or replaced by pus, and accumulating in quantity. This may occur in different degrees, both as to amount and rapidity of development; but the circumstance which here gives importance to this altered and more abundant secretion depends entirely upon the fact that it may become occluded within the sinus by means of the swelling and turgescence of the mucous membrane around its orifice. This, from such anatomical arrangement, converts a mere catarrhal inflammation, spending itself by superficial pus-shedding, into a shut expanding sac, in many respects equivalent to a deep-seated abscess, though by no means identical with that condition either in pathological history or absolute anatomy.

The *causes* of abscess of the antrum may be enumerated in very narrow limits. I believe that in adults, in the majority of cases beyond all computation, it is produced by dental caries, or at least by alveolar abscess, in some stage, associated with tooth-disease. It is stated that the affection may be brought on by a blow on the cheek; and an instance has been re-

[1] Lehrbuch der pathologischen Anatomie des Menschen und der Thiere, von Dr. A. W. Otto, p. 180. Berlin, 1830.

corded in which the malady has occurred in a new-born child, and was supposed to result from the pressure on the cheek during a hard labor.

The *symptoms* of antral abscess vary much in degree; but they usually commence by dull aching pain in the cheek, with heat, redness, and fulness of the soft parts externally. In the early stage there may, or may not, be a purulent discharge from the corresponding nostril; this, however, can only occur to any marked extent before the aperture between the middle meatus and the sinus is closed. As the case advances and the matter becomes pent up, the pain assumes a throbbing character and is severe, and constitutional symptoms manifest themselves analogous to those of acute abscess; the patient has rigors and fever. With this the local symptoms change, and an expansion of the whole jaw shows itself; the malar bone becomes elevated, the fossa beneath it full and prominent; the molar teeth on the affected side appear to elongate, and, in closure of the mouth, meet their opponents too soon: the concavity of the hard palate becomes flat or even convex; the nostril of that side is more or less closed, and, in severe and protracted cases, the floor of the orbit becomes so pushed up as to protrude the eye. Hunter, in describing the symptoms of antral abscess, speaks of the eye being sometimes "affected;" but in what manner he does not specify. Beyond instances in which protrusion of the globe[1] has occurred few have been recorded. The inflammation accompanying abscess of the antrum is, however, occasionally so severe as to implicate the periosteum, not only to the destruction of some parts of the maxilla, but extending beyond to contiguous fibrous structures, so as to involve the optic and other nerves in their passage from the cranial cavity to the orbit, producing blindness and fixedness of pupil on the affected side. Such cases are very rare; but one has occurred in my own practice at Guy's Hospital;[2] a second was under the care of Mr. Pollock; and a third is mentioned by Dr. Brück in Casper's Wochenschrift.[3] Necrosis of part of the jaw is one of the rarer accompaniments of this malady; but when any portion of the bone is affected, it is usually either the alveolar processes or the nasal plate of the maxilla.

The manual examination of the jaw seldom fails to indicate the fluid nature of the distending material; fluctuation can be felt, and the thinned bony parietes of the abscess convey to the touch a peculiar sensation, like the handling of dry parchment: as Jourdain very characteristically expresses it, "quand on appuyoit sur l'os, il s'affaissoit et revenoit ensuite sur lui-même en produisant une espèce de craquement."[1] If any doubt does arise as to the nature of the contents of an expanding antrum, I am in the habit of exploring the cavity with a minute trocar and canula not above half the size of a wheaten straw; by this means sufficient fluid, if present, may be made to escape to ascertain its nature, and it could scarcely do injury to a solid growth if such were the character of the expansion. A grooved needle would answer the same purpose, but hardly so readily. The fluid may be too dense to pass these narrow canals; generally, however, it is not thicker than ordinary pus, and it is sometimes serous.

The ultimate issue of these cases varies very much. Occasionally the abscess bursts into the nose: sometimes through the cheek; occasionally into an alveolar cavity, burrowing along the fang, and discharging its pus at the neck of the tooth. More rarely the floor of the orbit gives way, and the pus finds its exit somewhere along the lower lid. Occasionally the orifice which communicates between the antrum and the nose yields temporarily, and there is an accommodating escape of pus: as the patient lies on the other cheek, pus will stream from the nostril of the affected side and then stop, and again make its escape by the same exit.

The *treatment* of this malady is so admirably sketched out by Hunter that I cannot do better than quote his own words:

"The first part of the cure, as well as that of all other abscesses, is to make an opening, but not in the part where it threatens to point; for that would generally be through the skin of the cheek.

"If the disease is known early, before it has caused the destruction of the fore part of the bone, there are two ways of opening the abscess: one by perforating the partition between the antrum and the nose, which may be done; and the other by drawing the first or second grinder of that side, and perforating the partition

[1] An extreme case is mentioned by Frank, De Curandis Hominum Morbis, etc., auctore Joanne Petro Frank, lib. vi., pars 2, p. 22. Viennæ, 1820.

[2] "Case of Amaurosis from Abscess of the Antrum caused by a carious Tooth," by S. J. A. Salter, Med.-Chir. Trans., vol. xlv.

[3] Wiederholte Entzündungen des Antrum Highmori und Amaurose, etc., mitgetheilt vom Dr. T. H. Brück, in Casper's Wochenschrift, März, 1851, Berlin. A case of a similar character was described by Prof. Galezowski, in Archives générales de Médecine, tome xxiii., p. 261. Paris, 1830.

[1] Traité des Maladies, etc., de la Bouche, par M. Jourdain, tome i., p. 120. Paris, 1778.

between the roots of the alveolar process and the antrum, so that the matter may be discharged for the future that way.

"But if the fore part of the bone has been destroyed, an opening may be made on the inside of the lip, where the abscess most probably will be felt, but this will be more apt than the other perforation to heal, and thereby may occasion a new accumulation; which is to be avoided, if possible, by putting in practice all the common methods of preventing openings from healing or closing up; but this practice will rather prove troublesome; therefore the drawing of the tooth is to be preferred, because it is not so liable to this objection."[1]

Before the abscess has formed, and when, as yet, it is only imminent, it may be arrested by removing any carious tooth or teeth in the neighborhood; and the application of leeches, fomentations, etc., with the administration of purgatives. In those cases where the pus has already accumulated, and there is no outlet, it will be necessary to make a free opening for the evacuation of the matter; and the method, which universal experience has approved, consists in the removal of a tooth, and the perforation of the antrum at its base. This has the double advantage of removing the cause in most cases, and of allowing the discharge of the matter at the most dependent part of its containing sac. The tooth whose fangs are usually most intimately associated with the antrum is the first permanent molar; and its removal, in a case of antral abscess, is especially indicated from this circumstance, and from the frail and perishable nature of the tooth itself, which gives it less often than other teeth a long tenure of usefulness. The relation of the fangs of the molar teeth to the antrum is an important consideration in the treatment of this disease: in the largest proportion of cases caries of the first molar is the cause, and its removal (opening an alveolus for further perforation) is the first step in the treatment; but any other tooth, molar, bicuspid, or even canine, whose disease should be considered its cause, ought in preference to be extracted, as the absorption around the fang of a carious tooth would render the perforation of the antrum easy, while, by such a selection, this preliminary step would remove the exciting cause of the disease. Indeed, as a rule, it is well to extract all carious teeth from the side of the upper jaw affected with antral abscess. The extraction of the abscess-causing tooth is frequently followed by discharge of the contained pus, in consequence of the fang having extended into the antrum, or the floor of the sinus having been absorbed, resulting from the diseased tooth. It is generally necessary to enlarge the orifice into the antrum; and this is best effected by a naked trocar pushed up the socket of the extracted tooth: the trocar should be large, so as to break down a good deal of the floor of the antrum, thus making a free orifice for the discharge of matter. The absorption of bone which occurs around the fangs of carious teeth much facilitates piercing the antrum in this manner. Perforating the antrum occasionally requires considerable force; and it is necessary to apply this force with great care: the forefinger should be extended on the shaft of the trocar as a guard, and the instrument should be pressed forwards with an even rotating motion. If these precautions are not taken, the floor of the antrum will sometimes give way suddenly, the trocar will traverse the cavity of the sinus, and strike hard against the floor of the orbit, which it may even pierce. [The dental engine, with a proper drill, is by far the best instrument for this purpose, as it is entirely under the control of the operator.] I once saw this accident occur in the hands of a young operator, fortunately without any serious consequences. Occasionally antral abscess is associated with necrosis of some portion of the walls of the sinus; and if this should occur near its floor, the removal of the dead bone will supply an available orifice for the discharge of matter and the employment of injections. The presence of necrosed bone gives to the discharge the peculiar characteristic odor which is familiar to every surgeon: the offensive smell which the pus has, when simply long pent up, is a putridity of staleness, and quite distinct from the dead-bone fœtor. It may not be always easy to remove dead bone at once; and, in such a case, an outlet may be made in its neighborhood, which will allow the discharge of the matter, and assist in the coming away of the sequestrum when it is detached. If a case were to occur in which the teeth have been long removed, and the alveolar processes absorbed, the floor of the antrum would be more difficult to pierce, on account of the thick compact layer of bone which is constituted by the *osteal cicatrix* after the removal of the teeth. In such a case it would be more easy to enter the antrum by perforating at the base of the malar process of the maxillary bone, over the region formerly occupied by the second or third molar tooth. The mucous membrane should be divided first; and then the bone, when quite exposed, perforated by means of any

[1] Practical Treatise on the Diseases of the Teeth, by John Hunter, pp. 45, 46. 4to.: London, 1771.

instrument suitable for the purpose: a large trocar; or, as Sir B. Brodie suggests, a strong pair of scissors, closed and held firmly in the hand, should be *bored* into the part chosen for perforation. [With the modern appliances used in dentistry for drilling, there is no need to resort to such an antiquated instrument as a pair of scissors. The dental engine, with properly prepared drills, will penetrate easily and safely through any thickness of bone.]

When the antrum has been perforated, the next step is to secure the complete washing out of the cavity by injections, and the free and continued egress of the discharge by the artificial opening. Warm water should be abundantly used at first, so as to remove all the matter, which is sometimes inspissated. This will give great relief, and the swelling and inflammation will usually subside at once. Should the tendency to pus-secretion continue, an injection of sulphate of zinc, or what in an obstinate case I found very efficacious, a solution (gr. ij to the ounce) of nitrate of silver in distilled water, may be employed. I am in the habit of using a glass syringe with an ivory nozzle; fitted to the extremity of this is a bent silver tube. In using this apparatus, the silver tube is introduced into the opening in the antrum, and kept there while the syringe is filled and used; and withdrawn, refilled, and used again, many times. When the washing out of the antrum is completed, both the syringe and the silver tube are withdrawn; and now, unless some means are taken to prevent it, accidents of two kinds may occur;—first, food may pass through the orifice into the maxillary sinus; and secondly, the aperture thus artificially made, may close and cicatrize over. To prevent this, the plan usually adopted has been, to plug the orifice with a piece of wood, which effectually prevents both ill consequences. This is, however, a clumsy method: the same and further advantages may be gained by adopting a plan which I have followed in some recent cases. After the perforation through the alveolar cavity has been made, I have taken a model, and a plate has been prepared to pass over the space occupied by the extracted tooth, and fastened to the contiguous teeth by the customary metallic bands. Through this plate a hole has been bored, which corresponds to the orifice into the antrum; and to the applied surface of the plate a very short tube has been soldered, sufficiently long just to enter the antrum, to occupy the perforation, and prevent its closure. This plate has been permanently fixed during the active treatment of the case, and the orifice in the tube has been kept closed by a plug of cork in the intervals between using the injection. By the removal of the cork, the nozzle of the syringe, which fitted the tube, could be applied, and the injection used any number of times, the tube being sufficiently short to allow the complete washing out of the cavity and escape of the fluid. This plan of treatment has the additional advantage, that when there is no further need of keeping open the artificial orifice, the plate over the gum facilitates its closure. By removing the tube, and closing the hole by a little sheet of metal soldered on, the passage of air and fluid from the mouth to the antrum is suspended, and the healing of the wound is thereby facilitated, as will be hereafter explained. (See section on the Application of Obturators, etc.)

If in operations for antral abscess any foreign body, which may have caused or be associated with it, such as the fang of a tooth, becomes loose in the sinus, it should be remembered that the cavity is occasionally divided, as shown by M. Giraldès,[1] by partial septa of bone projecting from its walls. In such an instance, the adventitious body may be pocketed in a circumscribed region of the sinus,[2] and can only be removed by some curved scooping instrument introduced into the antrum; and this septate condition too would materially interfere with the cleansing of the cavity by means of injections.

VII. *Dentigerous cysts.* — Dentigerous cysts are collections of serum, or some modification of serum, occurring in the maxillary bones, associated with and dependent upon impacted misplaced teeth.[3]

[1] Des Maladies du Sinus maxillaire, par M. Giraldès. Paris, 1851.

[2] An interesting example of this casualty is mentioned by Mr. Cattlin, in the Transactions of the Odontological Society, vol. ii., p. 38. London, 1861.

[3] The dentigerous cysts, to which I have above referred, are totally distinct in their origin and physiological meaning from those other tooth-bearing tumors which are found, some in the ovaries of females, and others variously distributed in the bodies of either sex. The dentigerous cysts occurring in the jaw are merely the result of misplacement of a tooth, or tooth-germs belonging to the jaw which contains them. The two other forms of dentigerous cyst neither belong to the individual in whom they are found, nor are they adventitious growths of disease, properly so called. They obviously represent a portion (more or less) of another individual, and indicate some curious aberration of the function of reproduction. The ovarian tumors which bear teeth, and many fœtal structures found in the ovary of the human female, I conceive to be the absolute equivalents of the virgin-

These serous cysts may result from the presence of a supernumerary tooth or teeth; but in every case recorded, and in all except one that have come within my knowledge, the tooth or teeth have been normal in their presence and serial character, though misplaced as regards position: further, in every recorded case, the tooth or teeth thus implicated in disease, have been of the successional or permanent set, though a solitary instance has happened in the practice of a friend of the author's, in which a temporary tooth was the dental element of one of these cysts. These tooth-bearing serous tumors are, therefore, to be looked upon only as the occasional complications of dentition, in which there is an accidental deviation in the anatomical position of some tooth or teeth. The cysts only arise when the tooth or teeth associated with them are embedded in the substance of the jaw-bone; they do not occur after the tooth has pierced the gum. The embedding of a tooth in the bone does not necessarily give rise to these serous collections, for that is by no means an uncommon occurrence, whereas dentigerous cysts are rare. There appear to be three circumstances which may either of them produce impaction of a tooth in the substance of the maxillary bones: the tooth may be originally developed too deep in the body of the jaw, and thus, though it grow in a right direction and in a right position as regards the series, it will never reach the alveolar margin; or while it may be sufficiently superficial, it takes an oblique direction of growth, so that it lies covered more or less in the axis of the bone; or, again, the position of the tooth and its line of growth may be originally normal, but from an arrest of the development of the fang it may fail to reach the alveolar edge, and so remain permanently impacted in the maxilla.[1] [While the possibility exists that a tooth may be impacted so deep that it can never attain the alveolar margin, it must be remembered that the tendency of all teeth, developed in a proper direction, is toward the surface, and this, in the majority of cases, they will sooner or later reach. This has, doubtless, given rise to the many reports of third dentition in old age.] This may occur to any tooth, and has been recorded as affecting most of the permanent set; but it is more common with some than with others: it has been more often met with as regards the upper permanent canines than any other teeth. In cases where a successional tooth is impacted in the jaw, its temporary predecessor is usually retained considerably after the natural period of shedding. When a tooth is thus situated, its fang is inclosed in a bony socket lined by periosteum, as in ordinary circumstances, while the crown of the tooth is free in a little bony loculus lined by that which was the so-called "enamel-pulp." This structure is clothed with a sort of epithelium, which is apt to assume the function of secreting fluid. After the enamel is completely formed, the soft membrane which rests upon the surface of the crown of the tooth frequently separates from it, the interval being occupied by a sort of serum. This is generally the result of some irritation or difficulty in tooth-cutting; and where the irritation runs on to acute inflammation, as in some cases of tedious eruption of wisdom-teeth, the secretion may become purulent. In the deep-seated cases of impaction of teeth, the action, is, I believe, always slow, and the secretion almost always serous.

The recorded instances of this condition are so few, that it is scarcely possible to generalize upon them: it may however be said that they have usually happened in young persons, at least have commenced in adolescence, shortly after, though sometimes before, the maturation of the impacted tooth. In the cases narrated, the upper grinders have been more

produced "zooids" of those intervertebrata which perfect the function of *parthenogenesis* in the reproduction of their kind: that the development of these so-called tumors is the physiological equivalent of this function, though the anatomical result is incomplete. (See "Ovarian Tumor containing Teeth," etc., by the author, in Guy's Hospital Reports, 3d series, vol. vi.) Those other tooth-bearing tumors which are found in various parts of the body, irrespective of sex, cannot be susceptible of the same explanation, but suggest the entanglement of an imperfect, or more or less perfect, ovum within the primary one. Teeth appear to be the most constant of the structures entering into the formation of these tumors; but they are associated with other tissues, even in more than one instance to the production of an entire fœtus. These developments receive a probable elucidation by those curious monstrosities occasionally noticed in the ova of birds, in which a small imperfect egg is found *within* a larger primary one—not the common monstrosity of *twin* yelks in one egg, but a distinct miniature egg *within* the larger. (See Retzius, in Oefversigt af Kongl. Vetenskaps-Akademiens Förhandlingar, Stockholm, 1847; Baron de Morogues, in Revue de Zoologie, 2e série, tome v., Paris, 1853.) Such a circumstance occurring in the human ovum may explain the presence of these dentigerous and many-tissued cysts inclosed within the body.

[1] "On the Impaction of permanent Teeth in the substance of the Maxillary Bones," by S. J. A. Salter, in Guy's Hosp. Rep., vol. v., 3d series.

frequently involved than other teeth, the serous cysts dilating into the maxillary sinus: but incisors, canines, premolars, and molars, have all been associated with this condition.

M. Jourdain[1] describes three cases of dentigerous cysts. The first case he records was that of a girl, seventeen years old, in whom the right upper first and second permanent molars were inverted, and a large serous cyst had expanded around them into the antrum, with great dilatation of the body of the bone, distortion of the side of the face, and closure of the nostril: it had existed "some months." In a second example, a man about sixty years of age suffered from a tumor the size of a pigeon's egg in his upper jaw, for many months, closing the nostril of that side; it was caused by the expansion of a cyst around the second premolar, which was impacted deep in the substance of the bone. The third instance occurred in a girl, thirteen years of age, from a monstrous permanent lateral incisor (side not stated) being embedded in the intermaxillary bone, above and behind the root of the central incisor; "there was a considerable tumor, which occupied anteriorly the whole region of the maxillary hollow." It had existed for a year.

Dupuytren[2] describes a specimen shown to him by M. Loir, in which a cyst was developed in the left superior maxilla; this cyst involved, and was dependent upon, the presence of the canine tooth in a reversed position.

I was informed of a case of this disease by my late colleague, Mr. Bransby Cooper, in which great swelling occurred in the substance of the superior maxilla of a young man, in whose mouth the first and second permanent molar teeth had never made their appearance. A free opening was cut into the expansion, when the wanting teeth were found inverted in the axis of a serous cyst expanding into the antrum. No account of this case appears in Mr. B. Cooper's Lectures on Surgery, but I took memoranda of its particulars when communicated to him.

Mr. Wormald operated on a boy, about fourteen years of age, some time since, at St. Bartholomew's Hospital, in whom a serous cyst had expanded about the second bicuspid tooth of the lower jaw; the cyst was the size of a large chestnut, and was in the axis of the bone: the fang of the tooth was not fully developed. The interior of the cyst was lined with a thick vascular membrane, and it contained a glairy fluid. Mr. Wormald has favored me with these particulars.

F. E. Glaswald published a very learned discourse on this malady, at the University of Greifswald, in 1844, containing a complete résumé of the literature of the subject.[1] The text, upon which this essay was elaborated, was a case that had been under the care and treatment of Prof. Baum. In this instance a cyst had dilated each antrum to an enormous extent, and with hideous disfigurement of feature. The patient was a woman, thirty-eight years of age, and the disease was said to have been in progressive existence for thirty years. From a cyst in the right antrum a canine tooth was removed, and from the left a molar. The fluid in the cysts was purulent.

Three instances of this condition have occurred in my own practice. In one a serous cyst expanded the left angle of the lower jaw in a young man twenty-two years of age, resulting from the impaction of the dens sapientiæ. The cyst was very large, and had been twice opened to allow the escape of the serum, which had in each instance rapidly re-collected. I extracted the second molar, which was loose: this ruptured the cyst, liberated the serum, and freed the impacted tooth; its crown appeared in the alveolus of the second molar, whose posterior fang was greatly absorbed by the progress of the cyst. The case was entirely cured by this means alone; and the dens sapientiæ gradually rose into the mouth in an oblique position. The second example is very interesting in a diagnostic point of view. A girl, eighteen years of age, had an elastic fluid-containing tumor in the substance of the incisive bone, extending up to the base of the nose on the left side. She had been seen by two or three surgeons; but the nature of the malady was not ascertained. She had the normal *number* of teeth in the jaw, though the *character* of one of them was abnormal for her age. When the patient was sent to me for my opinion, I perceived that the left central incisor was a *temporary* tooth; and the circumstance was a key to a correct diagnosis of the case. The left temporary central incisor occupied a position which its permanent successor should have held: the absence of the tooth, under such circumstances, suggested the almost inevitable position which it must occupy above and behind its temporary predecessor, that is, in the axis of the serous cyst. The temporary tooth was removed, and the cyst explored to discover the succeeding tooth. The

[1] Traité des Maladies de la Bouche, par M. Jourdain, tome i., pp. 119–125. Paris, 1778.

[2] Leçons orales de Clinique chirur., Dupuytren, tome iii., p. 8. Paris, 1833.

[1] De Tumore quodam utriusque Antri Highmori perversa dentium formatione exorto, auctore Fr. Edw. Glaswald; Gryphiæ, 1844.

permanent central incisor was found deep in the bone, in an upright and natural direction, its crown bare within the cyst; but upon its removal it was observed that the fang was aborted, and had only grown to one-fifth its natural length. This circumstance it was which had prevented its extruding its temporary predecessor, and establishing itself in its normal position. The retention of the tooth in its epithelioid sac furnished the anatomical grounds from which, under favoring circumstances of irritation, the serous secretion arose, and the bone-expansion followed. The third case was that of a gentleman about forty years of age. A cyst the size of a pigeon's egg had expanded around the second bicuspid on the left side, the tooth being impacted in the jaw. The fluid in the sac was thick, very dark yellow-coloured serum, containing a large quantity of cholesterine plates.

Pathological specimens of uncommon diseases, and those too not killing or shortening life, must necessarily be very rare. This applies to specimens illustrative of the disease we are considering. One is in the possession of Mr. Samuel Cartwright, Jr., and is valuable and instructive in many points.[1] The preparation consists of a right superior maxilla—an adult bone: the teeth that remain, and the alveoli from which others have been extracted, show that the normal number of permanent teeth had developed in their natural position. The turbinated bones are gone, and the antrum maxillare is open. In the antrum, starting from its base, but not attached to its lateral walls anywhere, is an exceedingly thin, delicate capsule of bone, about the size of a chestnut, white with a granulated surface. The bony capsule contains nothing but one small *supernumerary* tooth, which is *loose* and *free* in the cavity. There are three important points in this specimen bearing on the anatomy and history of these cases:—the tooth is a supernumerary one; it is free and wholly detached in the cavity of the cyst; and further, the expansion is not that of the antral wall itself, with the tooth's crown uncovered within it, but a distension of that which was the bony loculus of the contained tooth, which, by its further dilatation, would have expanded the antral wall, and probably have been confounded with it.

This latter circumstance appears to me to be of much anatomical interest in reference to those serous expansions of the antrum which are associated with inverted teeth. These have hitherto been described as cysts of the antrum itself: but I cannot conceive that a tooth being "cut" through the mucous membrane of the antrum should produce such a result. The appearance of the crown of an inverted tooth in the nostril neither causes irritation nor increased secretion—at least no such consequence followed the three examples I have seen; and it seems to me to be far more probable that these cases have commenced as cysts within the bone at the base of the maxillary sinus, expanding into it, and ultimately filling its whole cavity and dilating its walls.

Two specimens in the museum at St. Bartholomew's Hospital throw some further light on the pathology of this condition. One preparation (numbered I. 119) exhibits a thin bony cyst, the size of a small Tangerine orange, with a thick membranous lining: it contained an inferior permanent canine tooth, *loosely attached* to its walls. It was removed from the lower jaw in the region of the contained tooth. The other preparation (I. 119*a*) is the superior maxilla of a young sheep, in which the central incisor is attached to the side of a large cyst; the *fang* of the tooth being *almost wholly destitute of bony covering*. This denudation of the fang does not appear to exist in the early stages of these cases, but seems to be brought about by great expansion of the cyst, and the progressive absorption of bone which accompanies it.

In one instance only am I aware of a dentigerous cyst being associated with a *temporary* tooth. It occurred in the practice of my late friend Mr. Alexander Edwards, of Edinburgh. The patient was a young man, in whose upper jaw, just below the orbit, a tumor had developed: the tumor consisted of an exostosis from the maxilla, combined with a bony cyst, containing a tooth, which was pronounced by Prof. Goodsir to be a temporary molar: from a portion of the tooth, which I afterwards saw, it appeared to be the second, the larger of the two.[1]

[1] Through the kindness of my friend, Mr. Cartwright, I have been allowed to figure this specimen. See Guy's Hosp. Rep., 3d ser., vol. v., p. 328.

[1] Other examples of dentigerous cysts may be referred to: "Tumor of the Upper Jaw depending on Cysts connected with the Presence of Teeth in a Preternatural Situation," by James Syme, Esq., in Edinb. Med. and Surg. Journal, vol. v., p. 381. Edinb., 1838. "Tumor formed by the Capsule of an uncut permanent Tooth," by T. Wormald, Esq., Lancet, vol. i., p. 756, 1850. "Dentigerous Cysts," in Stanley's Diseases of the Bones, pl. xviii., p. 20 of Illustrations. London, 1849. "Three Cases of Dentigerous Cysts," in Forget's Des Anomalies dentaires, etc., Obs. x., xi., xii., pp. 41–47. Paris, 1859. "Case of Bony Dentigerous Cyst of the Lower Jaw," by S. W. Fearn, in Brit. Med. Journal,

The *symptoms* of a dentigerous cyst are almost wholly local, consisting of a general expansion of the jaw-bone at some particular spot; accompanied by a corresponding disfigurement of the neighboring features, and a sense of weight and tension at the affected part. Where the impacted tooth has produced pressure upon a neighbor, the symptoms of pain and local distress have been more considerable, and have given rise to some constitutional irritation.

Upon manipulation the fingers readily perceive that the tumor is a central expansion of bone, and that it contains fluid; the bony walls yield to pressure, and then return to shape with that peculiar kind of crepitation which Jourdain characteristically calls *craquement*, like the doubling of stiff parchment; and the bone is usually sufficiently thin at some part to allow the production of fluctuation under the pressure of alternate fingers.

One of the most usual symptoms, and which is also an important *diagnostic sign*, is the absence from the mouth of some tooth or teeth which should have appeared, and have never been extracted. The presence of a fluid-containing tumor within the substance of a maxillary bone at the region of a tooth which is missing, and known always to have been wanting, would be well-nigh conclusive as to its being a dentigerous cyst, though the presence (or the past-known presence) of every mature tooth would not necessarily prove the reverse; for the dental element in the case may be a temporary or a supernumerary tooth. However, an impacted temporary tooth is a very great rarity, and one producing a serous cyst still more uncommon: the same may be said of a supernumerary tooth. The diagnosis may be further advanced by exploring the cyst, either by means of a grooved needle or trocar, when a serous discharge would support the idea of a tooth-cyst; and if the cavity be laid open, a probe will scarcely fail to discover the hard unyielding substance of the crown of the tooth.

The *treatment* of these cases is obvious, and usually quite efficacious. It consists in evacuating the contents of the cyst, extracting the tooth or teeth imbedded in it, and where the expansion is large, in removing some of the dilated bone. The operations should be performed as early as possible, so as to prevent the necessity of cutting away much bone, and the prolonged and tedious absorption which would follow before the face or jaw assumes its natural form. All cutting should, if possible, be done within the mouth. Generally a portion of the wall of the cyst may be removed readily enough with the scalpel; but where the involved tooth is reversed, the expansion is likely to be away from the alveolar border. In that case bone-nippers, the extraction of contiguous teeth, or even the saw, may be necessary. This has been especially the case where inverted teeth have caused cysts in the antrum. The tooth is likely to be found at the base of the cyst, further, *i. e.*, from its thinnest expansion. Some difficulty may be found in getting hold of and removing the embedded tooth; but various long-bladed extracting forceps may be readily devised to suit any case if a difficulty should arise.

In some cases, from a persistence of the serous secretion, it has been found necessary to inject the cyst with astringent and stimulating injections.

The issue of these cases is, I believe, always satisfactory. I am not aware that it ever led to necrosis or other bone disease. In one instance which I saw, a fibrous tumor grew from the cicatrix of a wound some months after the first operation: this was removed, and did not recur.

VIII. Alveolar and maxillary necrosis from (*a*) *Phosphorus fumes;* (*b*) *Eruptive fevers.*

The relation of the phosphorus poison to the disease in question, and its method of introduction, or rather application, are among the most distinctly proved of any of the circumstances connected with the history of disease. Probably there is nothing in pathological history where clear data, and simple induction from those data, have more lucidly illustrated the questions of cause and effect. To bring about the "phosphorus disease," phosphorus in some form must be applied to the periosteum, or, what is equivalent to the periosteum, to some raw vascular surface in immediate connection with the nutrition of bone; and the application must be prolonged, must be under particular circumstances of temperature, and probably of oxidation. These conditions alone occur in those manufactories where phosphorus is employed in the making of lucifer-matches; and there alone (or scarcely with exception) it is that this disease is manifested. But the circumstance which connects the outward cause with the disease that follows it, is a predisposition in the individual, consisting of some exposure of the periosteum, or what is tantamount to such exposure. The only manner in which this occurs, at least in which phosphorus appears to be effective in causing bone-necrosis, is where caries of a tooth exposes the pulp to the poison-

No. 191, p. 241, 1864. Heath's Injuries and Diseases of the Jaws, p. 158. London, 1868.

influence, the bone-necrosis being that of the jaw. It is the poisoning of the tooth-pulp that is the essence of the disease; the severe combinations of bone-affection, which give all the importance to the malady, are but contingent and secondary consequences. It is this fact in the essential nature of the disease that links it (as I think) to that other form of maxillary necrosis which occurs in children after attacks of the eruptive fevers; only that, whereas in the phosphorus disease the poison is applied to the tooth from an extraneous source—from without—in the jaw-necrosis of eruptive fevers the poison is generated within, and alights upon the teeth and tooth-pulps, by virtue of their being dermal organs, members of the tegumentary system, upon which system generally the eruptive-fever poisons spend their chief destructive force.

Phosphorus disease.—The necrosis and exfoliation of portions of the jaw-bones, dependent on phosphorus fumes as its cause, is so entirely associated with the manufacture of lucifer-matches, that not only are all the particulars we know of the malady derived from the victims of that occupation, but the disease itself was not known to have an existence until some years after these light-producing agents had taken the place of the old tinder-box, and by the large demand for them had given rise to extensive laboratories for their production.

The earliest published account of the disease which we have is by Lorinser,[1] of the Bezirks-Krankenhause Wieden; and the first case which fell under his notice occurred in 1839, about eleven years after the opening of lucifer-match manufactories in Vienna. In this country, as far as I am aware, the malady was first recorded by Dr. Wilks, in "Surgical Reports of Guy's Hospital," from April, 1846, to March, 1847, where he remarks: "Of the other diseases of the lower jaw, one occurred in a lucifer-matchmaker, with suppuration and exfoliation of bone."[2] It is, however, to the continental surgeons, and those principally of Germany, that we are indebted for the complete and early account of this malady, from which all subsequent notices have been mainly derived. Besides the original memoir by Lorinser, before referred to, important contributions have been added by Strohl,[3] Heyfelder,[2] Roussel and Gendrin,[3] Sédillot,[4] Ebel,[5] and, above all, by Von Bibra and Geist,[6] whose exhaustive treatise, their joint production, has given the clearest elucidation of this new disease.

The most important article on this subject that has appeared in this country has been written by Dr. Bristowe, in the form of a Report to the Privy Council "On the Relation of Phosphorus and its Manufactures to the Question of Public Health."[7]

[Among American papers on this subject, may be mentioned one by Dr. James R. Wood, of New York, New York Journal of Medicine, May, 1856; one by Dr. William Hunt, of Philadelphia, American Journal of Medical Sciences, 1865; and one by Dr. T. G. Morton, of Philadelphia, in "Surgery of the Pennsylvania Hospital," p. 216.]

That the *cause* of the maxillary necrosis and exfoliation occurring among the artisans employed in making lucifer-matches is the fumes of the phosphorus, need not be discussed; the question has been already settled; and the reader is referred to the writings of the authors above

[1] I have had no opportunity of consulting Lorinser's original writings: they are referred to by Geist as—"in den medicinischen Jahrbüchern des k.k. Oesterreichischen Staates, Jahrgang 1845, Märzheft."

[2] Guy's Hospital Reports, 2d series, vol. xii., p. 163. London, 1847. This case occurred in the hospital practice of the late Mr. Aston Key, who, as Dr. Wilks informs the author, was already aware, from his own observation, of the essential nature of the disease and its relation to its peculiar cause.

[1] Gazette médicale de Strasbourg, cinquième année, No. 11, 20 novembre, 1845.

[2] Vierteljahrsschrift von Roser und Wunderlich, Jahrgang 1845, Heft 3; and Medicinische Zeitung des Vereins für Heilkunde in Preussen, Jahrgang 1845, No. 45.

[3] Recherches sur les Maladies des Ouvriers employés à la fabrication des Allumettes chimiques, etc. Mémoire présenté à l'Académie des Sciences, le 16 février, 1846.

[4] Comptes-rendus des séances de l'Académie royale des Sciences de Paris, mars, 1846.

[5] Ueber den Einfluss der Phosphorzündholzfabrication auf die Gesundheit der Arbeiter. Mitgeheilt von Dr. Ebel. In Casper's Wochenschrift, 15 März, 1851.

[6] Die Krankheiten der Arbeiter in den Phosphorzündholzfabriken, etc., Erlangen, 1847; also Die Regeneration des Unterkiefers nach totaler Necrose durch Phosphordämpfe, von L. Geist, Erlangen, 1852. An admirable digest of this subject has been published, in the shape of a review of Von Bibra and Geist's work, in the British and Foreign Medico-Chirurgical Review for April, 1848.

[7] "On the Manufactories in which Phosphorus is Produced or Employed," in the Fifth Report of the Medical Officer of the Privy Council, p. 162. London, 1863. I may mention that my article on this subject in the first edition of this work was in type before the publication of Dr. Bristowe's report, though from the delay in the issue of the fourth volume it did not appear till a year afterwards. But Dr. Bristowe was furnished with a copy of my paper, from which indeed he makes quotations.

named, especially Von Bibra and Geist, for the consideration of this point. The only question on this head which deserved serious inquiry arose from the fact, that the phosphorus employed was often impure, and contained a notable quantity of arsenic; and this Martius and Dupasquier considered might be the essential cause of the malady: but this supposition was not found to hold good under more critical and extended examination.[1] It is only when the cause has been long in operation, and under circumstances of great intensity, that the disease is developed; it is confined almost entirely to those who are employed in the process of *dipping* the matches into the fused and reeking phosphorus compound, and those who dry them in the same apartment. Moreover, a long exposure to the influence is necessary for the production of the disease. Lucifer-manufactories had existed eleven years in Vienna, when in 1839 Lorinser observed the first case which attracted attention; and the shortest known period in which the malady has developed itself was in an instance which occurred in Paris, and is recorded by Gendrin, in which the patient had been employed in the occupation two years before the first symptoms appeared. Another circumstance of curious import, though not invalidating the generally-received doctrine of local poisoning, is, that the sufferer may have been removed from the baneful influence for a considerable period, and nevertheless be subsequently attacked by the disease.

Strohl gives an instance of a girl who had worked as a *dipper* at a lucifer-match manufactory for five years; she left that employment, and adopted a totally different and healthy occupation, when, after three months, she was, for the first time, attacked with unmistakable symptoms of the phosphorous disease, ending, after fifteen months, in exfoliation of portions of the superior maxilla.

It is very seldom that others than those employed in making lucifer-matches suffer from this malady; but that this may happen should not be lost sight of.

Pluskal[1] mentions an example of a little girl, seven years of age, who was in the constant habit of playing with matches, standing before a wall and discharging them in the dark for amusement, so that her face was bathed in their fumes; in time she was attacked with necrosis and exfoliation of small portions of the front of the lower jaw, with the ordinary attendant symptoms. Simon

[1] The actual agent in producing the phosphorus disease is doubtless oxidized phosphorus, probably in the form of phosphorous or phosphoric acid, dissolved in the saliva. The precise nature of the fumes is not exactly known; they consist principally of phosphorous acid (H_3PO_6), which by mixture with air becomes phosphoric acid (H_3PO_8); and probably minute quantities of phosphorus-vapor (P), phosphuretted hydrogen (H_3P), and hypophosphorous acid (H_3PO_4), are also present. Any vapor of phosphorus and hypophosphorous acid would be speedily converted by the air into phosphorous and phosphoric acids. Phosphuretted hydrogen would be more slowly oxidized into the same products. At any rate, nearly if not quite the whole of the fumes when inhaled by the work-people would be in a state of some acid of phosphorus capable of being fixed and neutralized by an alkali. Such being the case, it is greatly to be regretted that efficient sanitary measures are not adopted to prevent the disease, which surely might be done. The recommendations of Geist and Roussel amount simply to cleanliness and ventilation, and are not sufficient. I would suggest, that in all lucifer-match manufactories there should be a periodic and rigid scrutiny of the mouths of all the work-people employed. Those having faulty teeth should be excluded from the rooms (the *dipping* and *drying* rooms) where the obnoxious fumes are being developed. All carious teeth should be extracted or plugged. What is more important—a very simple and effectual respirator for the mouth might be worn by the employés; it would be unnecessary over the nostrils. It should be constructed on the ordinary plan of respirators, but its centre consisting of a porous diaphragm, such as sponge or some woven fabric, linen or cotton, which should be daily dipped in a solution of one of the fixed alkalies or their carbonates. This would arrest nearly, if not quite, all the acid fumes of the phosphorus. Or the respirator devised by Mr. Graham for persons exposed to carbonic acid vapor would probably be as efficacious. It consists of the mixture in equal bulk of fresh-slacked lime and sulphate of soda, through a cushion of which it is easy to breathe. The wearing of some such respirator should be compulsory with the dippers and dryers. Again, the acid vapor might be neutralized and rendered innocuous by keeping the atmosphere of the apartment ammoniuretted. I believe, if these precautions were adopted, the disease would seldom, if ever, manifest itself.

There is a curious modification of phosphorus, known as "amorphous" phosphorus, which does not emit noxious fumes when heated sufficiently for its employment in match-making. This kind, however, is not mixed with chlorate of potash (which furnishes the oxygen) for tipping the matches, but is employed to coat the rubber on the surface of the box against which, by friction, the chlorate of potash match is ignited. These matches deserve universal adoption, for not only are they made without possible injury to the work-people, but they are quite safe, being incapable of accidental ignition.

[1] Oesterreichische medicinische Wochenschrift, No. 30. Wien, den 25 Juli, 1846.

narrates a case in which the disease appears to have been brought on by a person chewing pieces of ginger, which he kept in his pocket with some lucifer matches. And Mr. Paget describes[1] a case in which the malady was induced by the manufacture of medicines in which phosphorus was employed.

The influence of the phosphorus fumes upon the jaw is undoubtedly local. Lorinser, who has the merit of discovering this disease, held a different opinion, but Roussel, Geist, and indeed subsequent writers generally, have adopted the opinion, which all the evidence upon this point seems clearly to establish.[2] I have not space here to enter upon the argument of the question; I may, however, mention one telling fact; it is, the necessity of dental caries in the individual before the disease can be produced. It has never been known to occur, excepting where the sufferer has had carious teeth, and many persons have worked in the manufactories for a long series of years with perfect impunity, who, upon the supervention of dental caries, have been attacked with the malady. Dental caries, by opening the central chamber of the tooth and exposing the pulp, seems to offer a tolerably direct channel for the poison to be communicated to the subjacent periosteum, and this, no doubt, is why tooth-destruction is a necessary pre-existing condition. What the precise nature of the action of phosphorus-oxide thus absorbed may be upon the bone, is a matter of speculation, but the particular nature of the poison, entering as it does so largely into the composition of the skeleton, is a suggestive circumstance: perhaps, if accumulated by the periosteum, it may generate on the bone's surface a condition of chemical *superphosphate*, inconsistent with osteal vitality.

The *symptoms* of phosphorus-necrosis do not differ essentially from other forms of necrosis in the same parts: they are, however, not infrequently accompanied by bronchial and pulmonary irritation from inhalation of the fumes: this has been especially pointed out by Sédillot, Gendrin, and Dupasquier.[3] And one of the patients whom I have seen, affected with this malady, has detailed to me symptoms of *spasmodic asthma* which occasionally supervened when he was employed for many continuous hours "*dipping*" while suffering from a common "cold" in winter weather. Barring this occasional manifestation of pulmonary irritation, the general health of these work-people is remarkably good.

The symptoms of the jaw disease usually commence with what is supposed to be tooth-ache, the pain being at first pretty much localized to some one tooth that is carious, and which is probably the channel by which the poison is introduced. The advance of the disease is generally slow at first, and, as it were, undecided—indeed, indefinitely chronic; the pain is inconstant, and not early attended with more serious symptoms; presently, however, it becomes more severe and erratic, extending vaguely about the side of the head and down towards the shoulder, and with this severer pain swelling and extreme tenderness occur; the integument near the affected region becomes red, tense, and distended, while the teeth feel elongated and intensely painful when brought in contact with their fellows of the opposite jaw, and they become very loose. The gums are swollen and livid, and this condition extends to the mucous membrane of the cheek. All these symptoms increase till suppuration is established, and with them, more or less symptomatic fever is developed in proportion to the severity and extent of the disease: the patient has rigors and pyrexia, and is often thoroughly ill. The point at which the pus finds its discharge varies a good deal: the soft parts first become very boggy, especially the gums, and matter often escapes early around the necks of the loose dead teeth; when pointing externally, its approach is accompanied by intense glistening erysipelas-like redness of the integument. The discharge of the pus is attended with great mitigation of the patient's suffering. The pus itself is often sanious at first, and very fetid, having the odor characteristic of the presence of necrosed bone. The orifice of discharge frequently leads to long burrowing sinuses, especially where the lower jaw is affected; and through these the dead bone may be detected by a probe. The swelling which attends the disease is often very great, particularly when the lower jaw is necrosed: it is diffuse and widespread, encasing the external and under surface of the bone in a prodigious, dense, plastic exudation. In very severe cases, previous to the discharge of pus, while the inflammatory symptoms are at their extreme height, the whole head, except the summit of the scalp, is involved—the eyes are closed; the nose, and even the forehead, swollen; the cheeks, lips, neck, and throat, are one continuous area of florid intumescence. It is a curious circumstance that in the lower jaw the necrosis is attended with a very large and

[1] Medical Times and Gazette, vol. i., p. 41, 1862.

[2] The arguments bearing upon this question, and the conclusive inference to which they lead, are stated with cogent force in an admirable clinical lecture on this subject by Mr. Simon, in the Lancet for 1850, p. 41.

[3] Gaz. méd. de Paris, 1846, No. 49.

complete development of ossifying callus, whereas none is formed when the upper jaw is affected. The large plastic exudation which surrounds the base of the lower jaw becomes converted into a mass of supplemental bone, supporting the sequestrum, which is, for the most part, naked and bare within and behind, and connecting sound portions of bone at its extremities when the whole of the maxillary arch is not involved. Geist assumes that the particular region occupied by the osteophytic incrustation about the lower jaw is the result of gravitation—an idea altogether too mechanical: it is rather to be looked upon as a physiological manifestation, and one element in that marvelous exhibition of the *vis medicatrix naturæ* which this repair of the lower jaw displays: the supplemental bone thus placed forms the best support for the sequestrum, and the least interferes with the functions of the mouth; while the absence of an ossifying callus at the upper and inner region of the maxillary arch offers the readiest escape of the dead bone through the thin mucous membrane which there alone covers it, and this without damaging the integument of the face.

As the bone becomes laid bare by the ulceration of the soft parts, it is observed bathed in ichorous pus, ragged and irregular in its surface, and of a dirty blackish gray color: this latter condition is said to be invariable, as though characteristic; but it is not so, for although very general, I have seen specimens white and clean, and with the compact external layer of bone intact.

To return to the symptoms of the disease. When the extent of necrosis is very great, the constitutional disturbance is correspondingly severe; and in the early stages of the malady the patient may have intense fever, with delirium and agonizing local suffering, the more distressing from the region which the affection occupies—interfering with or altogether suspending the action of the mouth, and by the secretion of foul and fetid pus, producing nausea, ructus, vomiting. The looseness and projection of the dead teeth is another source of annoyance and distress: as the sequestra containing them emerge from the surrounding parts, their elongation and angularity much irritate the gums and cheek in contact with them. In the severest cases, general sphacelus of the soft parts about the jaw, with œdema of the face and neck, may supervene, accompanied, or not, by erysipelas; and death may then close a scene of terrible suffering. In other instances with a fatal issue, life is drawn out through many months of tedious illness, varied by different degrees of local irritation; till at length the patient, with vital endurance inadequate to the requirements of the disease, sinks, tabid and exhausted, under continuous hectic, and not infrequently with tubercular complications.

But the pathological changes may be more terrible than those already mentioned.

Dr. Ebel describes a case which occurred in the practice of Dr. Hervieux at the Hospital Necker, in which the patient, a lucifer-match maker, first had necrosis of the lower jaw, then of the upper, afterwards of the palate bones and the orbits, and lastly of the os frontis. He died with brain symptoms. Pus was found between the dura mater and the brain.

When the malady progresses to a favorable issue, which it does in the majority of cases, the dead bone gradually loosens and becomes detached; and this is generally anticipated by the falling out of some of the necrosed teeth. In the upper jaw the sequestra are usually more broken up and smaller than in the lower, and they are shed easier, not being held in and detained by ossifying callus, which is always wanting in the upper jaw. In the lower jaw the sequestra are usually more extensive, often including large portions of the body of the bone, not infrequently the ascending rami, and sometimes the coronoid processes, and even the articular condyles. The shedding of these sequestra is often hindered by the large surrounding ossifying callus which always forms when the lower jaw is the subject of this disease.

I may here mention that some stress has been laid upon the circumstance that the lower jaw has been more frequently observed to be affected than the upper. The learned reviewer[1] of Geist and Von Bibra's work has given much detail bearing on this point; he enumerates twenty-five examples in which the lower jaw was affected, to twenty-one in which it was confined to the upper jaw. In five cases which I have seen, the lower jaw was diseased in four, and the upper in one; whereas four, which occurred in the practice of a surgical friend, were confined to the upper jaw. In seventeen instances of which I have obtained particulars or seen specimens, nine were connected with the superior, and eight with the inferior maxilla. Dr. Bristowe, in his investigations, met with evidence of thirty-nine cases in the lower jaw, twelve in the upper, and five in both.

The results of phosphorus-necrosis, in cases which get well, are very various.

[1] British and Foreign Med.-Chir. Review, before cited.

As regards general health, the patient usually recovers with an elastic convalescence after the dead bone has been removed; but the physical condition of his maxillary apparatus is often terribly mutilated. When the front part of the upper jaw is affected, it is an absolute and unrepaired loss, miserably disfiguring the patient, altering the physiognomy most painfully; when it affects more hidden parts of the jaw, the loss is not less complete, though less conspicuous.

If the affection is confined to the inferior maxilla, the removal of the sequestrum leaves a supplemental bony representative, which for a time, more than makes up for the loss of dead bone, and for a long subsequent period efficiently performs the office of edentulous mastication, and supplies the wants of personal comeliness.

In some instances the whole of the lower jaw has been lost, excepting the articular condyles; and these, apparently connected with the new bone, have established the joint requirements of the supplemental jaw; but in other instances (cases in St. Bartholomew's Hospital, and those mentioned in Geist's later work[1]) even the articular ends have been shed with the rest of the sequestrum; still there has been joint movement, doubtless from a ligamentous attachment of the new bone.

This repair of the lower jaw is, however, but temporary: for after a time—often a considerable time—the new bone diminishes, by absorption, to a mere narrow arch, and ultimately, there is scarcely enough bone to keep out the lower lip, and the chin is utterly lost. I have had an opportunity of examining this state of parts after the lower jaw had been removed ten years. Dr. Bristowe, however, mentions two instances, one after six, and one after ten years, in which the supplementary bone remained large and well formed: but he describes another in which, after eight years, the new jaw was scarcely bigger than the hyoid bone. How far the loss by absorption of supplemental bone, may be prevented by supplying it with a function, through the means of artificial teeth, is a question of theoretical interest and of practical importance.

The *treatment* of phosphorus-necrosis of the maxillæ divides itself into that which is common to all bone-necrosis, and that which specially applies to the particular local affection in question. Upon the latter head alone I would remark.

In the early stages of the disease, when as yet it is not established, but its supervention feared, it would be of the last importance to remove the patient from the cause of the malady: pure air should be sought, abundant cleanliness, with urinary and alvine excretants, resorted to, and all suspicious teeth extracted. When, however, the local symptoms—extreme pain, swelling, and indurated infiltration of the soft parts—develop themselves, and the disease has already passed its premonitory stage, it will be advisable to have recourse to more active measures. Upon this point I cannot do better than quote Mr. Simon's remarks in his admirable Clinical Lecture, already referred to, and in the justice and propriety of which I entirely concur. "So soon as the second or inflammatory stage of the disease has thoroughly set in, the bone seems in every case to be irrevocably doomed to necrosis; and I would therefore recommend you, in the event of your being called to a case at the transition period between the two stages, when hypertrophy is passing into inflammation, to adopt without hesitation the most active measures for the relief of the periosteum and bone. Leeches and general antiphlogistic treatment *may* do good; but the consideration of the pathology of this disease, together with the analogy of other periosteal affections, leads me to believe that the only real chance of doing good would lie in still more energetic measures; and I would recommend you in any such instance, to make with your scalpel free vertical incisions through the gum wherever tenderness and swelling exist; extending your line of cut upwards in the upper jaw, or downwards in the lower, as far as the structure of the parts will allow, bringing your incisions as near together as circumstances may require, and in every point carrying them clearly down to the bone, so as to afford the utmost relief and relaxation to the overloaded and tense periosteum. I believe that this method of procedure would be the nearest approach to an effective one for checking the inflammatory stage of the disease before it has reached an intensity which must inevitably destroy the jaw."

When the stage of threatening has past, the extent of the inflammatory mischief appears to assert itself at once—the whole of that portion of bone which is subsequently the sequestrum appears to be stricken from the first. Prevention is at an end, and palliation rather than cure is indicated as the surgeon's mission. When pus has formed, it should be early conducted to the surface, and by judicious interference external scars may often be prevented by means of well-directed punctures within the mouth. The whole of the teeth implanted in the dead bone be-

[1] Die Regeneration des Unterkiefers nach totaler Necrose, v. L. Geist, 1852.

come loose, and apparently elongated; their doom is already sealed, and they should be extracted without delay, as they cause much irritation to the tongue and cheeks.

When the discharge has established itself, and the fetid pus is pouring from the sinuses that communicate with the dead bone, abundant rinsing of the mouth should be had recourse to, not only in the form of mere washes with water to remove the filthy secretions, but astringent and deodorizing lotions, such as decoction of cinchona, and solution of alum, solution of chloride of lime, and, still better, solution of permanganate of potash. As has been pointed out by Mr. Simon, the unhappy patients are sometimes so disabled as to be incapable of gargling out their mouths, and then little pieces of sponge may be used by them to wipe away the stinking discharges.

As regards the sequestra little can be done. Sharp projecting pieces of bone may be cut off by nippers; but the bulk of the dead bone must take its own time to be shed—often a very long time. It is a period of miserable suffering to the patient, and terrible constitutional exhaustion; but it cannot be shortened or its results anticipated.

In March, 1862, I saw in the London Hospital, under the care of Mr. Adams, a patient who had been suffering from the disease, affecting the entire inferior maxilla; it had been going on two years and a half; the latter four-fifths of the time with the lower jaw, except probably the articular ends, dead and lying in the mouth, bare and ghastly, bathed in ichorous pus within its huge supplemental successor.[1]

The sequestra of the superior maxilla are apt to be more detached than those of the inferior—divisible and smaller, and they can be brought away piecemeal; moreover, as the upper jaw is an attached, and not like the lower, a floating bone (with muscles ready to displace its parts when the integrity of its arch is broken), its dead portions can be removed without jeopardizing the relations of the rest of the bone. Therefore a little and early surgical interference may be employed without injury, and parts brought away which if belonging to the lower jaw, had better not be interfered with. In the lower jaw the disease is usually so much more comprehensive, and its resultant sequestrum is so solid, that patient watching and palliative treatment are all that can be adopted generally till the very close of the case. Earlier interference might disturb the relations of the supplemental bone (the *natural splint*) and the portions of jaw still living, and by allowing the strong antagonistic action of the muscles attached to the two halves of the latter to act separately, lead to the permanent displacement of the elements of the maxillary arch. The articular ends of the bone often—indeed, in the majority of cases, though not always—escape the necrosis, when the whole of the rest of the bone may be destroyed; and this circumstance suggests an element of treatment which may much shorten the patient's suffering. When the necrosis has evidently passed up to the neck of the condyles, the bone may be removed by sawing or nipping across the neck as high up as possible (on either side, if both sides are affected), and then dividing the body of the jaw at its symphysis; the two halves of the bone may be withdrawn, one by one, without any external wound. Should the condyles be necrosed and follow, no harm will have been done by the previous operation, and the patient's suffering will have been much diminished and curtailed. The division of the bone may be accomplished by a Hey's saw, or some modification of it improvised to suit the particular position of the required line of section. Variously curved bone-nippers may also be devised to accomplish the same objects. The extreme and firm closure of the mouth sometimes renders this operation very difficult.

I need not dwell upon the general treatment of these cases as far as they are in common with those of bone-necrosis generally. The particular region affected, however, involving and disabling, as it does, the masticatory function, entails some modifications. In the long tedium of their course every effort should be made to supply, by suitable food, the deficiencies which suspended mastication entails—mashed meat, eggs, cod-liver oil, and such sustainants, should be abundantly employed; and iron salts, in moderate proportion, should, if bearable by

[1] The necrosed jaw was afterwards removed. The operation and its sequence were both unusual. The patient was placed in a kneeling posture, with the chin on a table, and, the mouth being open, the symphysis of the jaw was split down by a chisel and mallet. The right half of the bone was then seized by large strong forceps, and wrenched from the mouth with great force. After a week the same course was adopted with the left half; but this required still greater traction. The entire bone was thus brought away, including the condyles. Ten days after the first operation the patient was seized with secondary hemorrhage, profuse and arterial, on the *right* side from the wound, where the first portion of jaw was removed. This necessitated ligature of the right common carotid artery. The later operation was performed by Mr. Maunder, and the patient recovered perfectly. See Med. Times and Gazette, July 5, 1862.

the patient, be almost a matter of daily diet rather than an occasional medicine.

There is one point which I would allude to—more a matter of pathological curiosity than as having any other bearing; it is the enormous amount of pus which these patients daily swallow and (apparently) digest. It must be many ounces, and this without any obvious detriment to health; the patient's condition being no worse than may be accounted for by the force of the local symptoms.

Exanthematous jaw-necrosis.—I believe that the necrosis and exfoliation of the alveolar processes and portions of the jaws in children, consequent upon the eruptive fevers, is essentially the same as the maxillary necrosis in the victims of phosphorus fumes, and that it is the result of the local application of a specific poison to the vascular parts of teeth. There is this difference, however, that in the cases we are now considering the poison is generated within the individual, but with affinities for certain structures and tendencies to action upon certain organs, which give its morbid consequences an equally local character. Whatever opinion may be entertained as to the homological relations of the several tissues of the teeth to those of the general integument, there can be no question as to their being members of the dermal system, and as such we should *à priori* expect that they would share the consequences which attend those particular diseases which spend their chief force on the skin. There is one circumstance, however, that modifies such an anticipation; it is the low state of vitality of the teeth, and the extremely slight nutritional changes which occur in them *when once they are formed*, and which must consequently remove them to a great extent from those transient though potent influences which would destroy or morbidly affect vascular or rapidly-growing tissues. But such a qualification does not apply to the conditions of the teeth during their development. From the time of birth till the eighth or ninth year, the jaw-bones are the seat of intense developmental nutrition in the formation of the teeth, and are among the most vascular parts of the body: about the middle of the period named, five years of age, the maxillæ contain no less than forty-eight developed teeth and developing tooth-germs. It is about this time that the poison of the exanthematous fevers appears to exert its most deadly influence on the dental system.

The form of necrosis affecting the alveolar edges of the maxillæ, and accompanied by the shedding of the teeth, which we are now considering, was, I believe, first recognized by myself[1] as one of the sequelæ of the exanthemata, and dependent necessarily on their previous occurrence. Many isolated cases of the affection have been described, and our museums contain specimens of the sequestra; but the supposed relation of cause and effect had not, so far as I know, been expressed before.[2]

This affection is by no means common, considering the almost universal occurrence of the eruptive fevers. The very large population tributary to Guy's Hospital has only furnished me with twenty-three or twenty-four cases during the last nine years; and I have reason to think that even in this I have been disproportionately favored.

The cases are all singularly alike. A little child has just recovered from one of the eruptive fevers, most probably scarlatina; the case has been in no way unusual as to its severity or its course: within six weeks or two months of the passing off of the acute symptoms, tenderness of the mouth is complained of, and the mother notices fetor of the breath. Upon inspecting the mouth, the gum is seen to be peeling from the edge of the jaw around the neck or necks of some temporary tooth or teeth; pus is discharging, and more or less dead bone is exposed. The denudation of the bone progresses rather quickly in depth, but usually not after the first in lateral extent; the temporary teeth at the affected part become loose, and often fall out. There is no swelling: and no ossifying callus is formed in the region of the necrosed bone. In a few weeks from the first of these symptoms, the sequestrum itself becomes loose, and is easily removed, leaving a large gap, and a raw granulating surface, which rapidly heals. The necrosis almost always includes the bone which constitutes the loculi containing the developing permanent teeth, as well as the alveoli of the temporary; but it does not go further, and in the lower jaw the base of the bone is very rarely affected. I have never seen such an occurrence. The disease is frequently symmetrical: when attacking the bone about the temporary molars on one side of the jaw (its most common situa-

[1] "On the Shedding of the Teeth, and Exfoliation of the Alveolar Processes, consequent upon the Eruptive Fevers," by S. J. A. Salter, Guy's Hospital Reports, 3d series, vol. iv. Several specimens of sequestra from these cases have been figured by the author in the Transactions of the Pathological Society, vol. xi., pp. 209–215.

[2] The earliest recorded cases are mentioned by Fox in his History and Treatment of the Diseases of the Teeth, p. 112, London, 1806. These cases, two in number, occurred after smallpox.

tion) it often manifests itself immediately after on the opposite side, and sometimes in the same regions of the other jaw. The same symmetry is observed in the front of the mouth.

As far as I am aware, this affection only occurs after the eruptive fevers,[1] and scarlatina is the most potent cause. In the instances which have been under my own care, two were after smallpox, five or six after measles, and fifteen or sixteen after scarlet fever. There is, however, nothing in the condition of the mouth to indicate which has been the precursor. The age at which this affection occurs is usually about five years; from three to eight are the extreme limits I have known.

The issue of these cases is simply comprised in the loss of a certain amount of bone with the contained teeth, and the consequent disfigurement. As the permanent teeth are lost with the temporary, the disfigurement is very great when it affects the incisors; but when the temporary molars and their successors, the bicuspids, suffer, the damage is comparatively slight. I have seen two examples of adults where this has happened in childhood, and the alteration of the face has been wonderfully little: the first molar approaches very close to the canine, and the second and third molars come well forward into the mouth, filling out the cheeks, and exhibiting no external evidence of what has occurred. In one solitary instance which I saw, in which the permanent tooth was not shed at the time when the bone and temporary tooth were lost, it was in effect equally destroyed, for the tooth was blighted—it did not grow after that time; no fang was formed, and when cut it remained a mere tooth-crown, loosely attached to the surface of the gum.

The *treatment* of these cases involves little beyond patience and cleanliness. No operative interference is indicated; the extent of the necrosis asserts itself from the first, and cannot be curtailed. Soon the sequestrum becomes loose, and may then be readily removed by dressing-forceps. I would suggest a weak solution of *permanganate of potash*, as a cleansing and deodorizing mouth-wash. Any general symptoms of disturbed health should be met on ordinary principles. Where the suppuration is profuse, and the bone-necrosis extensive, stimulants and tonics may be required; and in the scarlet-fever cases steel [iron] would be a useful adjunct; but I would observe, that in the cases I have seen, the children were, for convalescents, in remarkably good health, and had, almost without exception, escaped the other ill consequences of the eruptive fevers.

IX. *Hemorrhage after extraction of teeth.*—Long-continued and obstinate bleeding after the extraction of teeth is an occasional and troublesome complication of this operation. It is not a common consequence: indeed it is very rare, considering the enormous numbers of the operations, and how seldom in proportion continued bleeding follows them. The troublesome hemorrhage from the wound of an extracted tooth is of a peculiar character: it is not a rapid arterial discharge immediately following the vascular rupture which the tooth-extraction causes, but a continuous, abundant flow of blood welling up in the empty socket, and developing itself into a serious and sometimes alarming symptom, usually many hours after the operation. The profuse pouring-out of vivid arterial blood, which sometimes follows the drawing of a tooth, has no relation to the circumstance we are considering; that generally lasts but for a few minutes, and then ceases. The continued hemorrhage is not the discharge of any considerable arterial trunk that may have been wounded, as has been supposed, but the passive bleeding, as it seems, of the entire disrupted surface, from an inability of the vessels to accomplish the curative closure of their broken ends. In the majority of the recorded cases there has been distinct evidence of the existence of the hemorrhagic diathesis in the individual affected; and in not a few, the patients have themselves been aware of the tendency, from having experienced similar consequences attendant on the previous extraction of other teeth. Indeed, some persons (I have some such patients of my own) refuse to have any more teeth removed, preferring rather to suffer any amount of toothache, on account of the alarming hemorrhages which have followed the operations before.

[1] I have heard of one doubtful case after continued fever (typhus or typhoid); but this would form no real exception to these cases or their pathological interpretation. The continued fevers have their specific cutaneous eruptions; and their damaging influence on the tegumentary system is sufficiently attested by the falling of the hair in convalescents from them. I would not, however, be supposed to deny that jaw-necrosis, associated or not with death and exfoliation of other bones, may occur in children as the result only of extreme cachexia or depressed vital nutrition. Such instances are referred to in vol. iii. (DISEASES OF THE BONES). I merely wish to assert my belief that the particular form of alveolar necrosis above described is one of the *specific sequelæ* of the eruptive fevers, and is related to its cause in the manner indicated in the previous pages.

In one case which came under my treatment, there was no history of a hemorrhagic tendency; but the patient was a young lady, and the circumstance occurred just as menstruation was imminent. The bleeding was very considerable, and continued for two days, when under the influence of emmenagogues (hot hip-baths and aloetic purgatives), the catamenia appeared, and the hemorrhage from the alveolus immediately ceased. In this case, doubtless, the bleeding was a vicarious manifestation of the periodic function. A very interesting example of this distressing consequence of tooth-drawing, showing its constitutional nature, was under my care some years since. A clergyman from one of the midland counties came to town to me on account of the hemorrhage which had followed the extraction of a lower molar tooth three or four days before and was still continuing. He was reduced to a pitiable condition of exhaustion and bloodlessness. All the local means usually adopted had been tried, but without success; the bleeding, however, speedily ceased under the use of large and frequently-repeated doses of *tannin*. The history of this gentleman and his family is curious and instructive. As a boy, from the most trivial accidents, such as a cut finger, he sustained prolonged and almost irrepressible bleeding; during his whole life, the slightest blow or bruise would cause a large and very disproportioned ecchymosis; a few years before, he had sustained a week of hemorrhage, after the extraction of a tooth. This gentleman has three married sisters, all of whom suffer from terrible flooding at the birth of each child. He has a little boy, as liable to bleeding from a trivial wound as he was in his childhood.

It is of special importance to bear in mind the general and diathetic nature of alveolar hemorrhage, in devising its proper treatment. Anything which would increase the wound, or add a fresh one (such as the cautery or the ligature of an arterial trunk), is contra-indicated.

A fatal example of alveolar hemorrhage, in which both these means were adopted, is recorded in an early number of the Medico-Chirurgical Transactions.[1] The previous history of this patient is singularly like that of the clergyman whose case I have just mentioned, in the hemorrhagic diathesis manifesting itself in childhood, and his having sustained a terrible loss of blood—the bleeding lasting for twenty-one days—when another tooth was extracted before. In the treatment of this fatal hemorrhage, the actual cautery produced only a temporary arrest of bleeding; it was then determined to tie the carotid artery; the operation was performed by Sir B. Brodie, without any relief to the original symptoms; the wound in the neck only furnished another bleeding surface, and evidently hurried on the fatal catastrophe. In another recorded case where the cautery was used, the edge of the lip was accidentally burnt, and the surface thus cauterized soon commenced bleeding profusely, and continued to do so till the fatal termination of the case, which has hastened by it.

The *treatment* of this form of hemorrhage divides itself into local and general; the local treatment consisting in the application of styptics with continuous pressure upon the bleeding surface; the general treatment, in the rapid and abundant administration of internal astringents. The local plan of a plugging compress, recommended by Hunter, is that now universally adopted. "In general it will be sufficient to stuff the socket with lint, or lint dipped in oil of turpentine, and to apply a compress of lint, or a piece of cork thicker than the bodies of the adjacent teeth, so that the teeth in the opposite jaw may keep up a pressure. It has been advised to stuff into the socket some soft wax, on a supposition that it would mould itself to the cavity, and so stop the bleeding: this perhaps may sometimes answer better than the other method, and therefore should be tried when that fails."[1] The restoration of the extracted tooth to the socket has also been tried with success. [The tooth being previously dipped in melted wax.] For the purpose of forming a plug of lint, a strip [first dipped in melted wax] should be cut of an elongated wedge-shape, and this should be introduced, the pointed end first; the extremity should be introduced into the bleeding socket, and driven well home to the bottom; the strip of lint should then be folded and re-folded upon itself, so as to make the plug very solid and pressing on the entire superficies of the socket. When the compress of lint or cork has been applied, the mouth should be closed and the jaws kept permanently together, so as to exert considerable and persistent pressure by means of a broad bandage tied under the chin and over the head. [Where the bleeding occurs from the entire surface of the gum, other means must be resorted to than those already described. A metal plate (silver will answer) should be procured and bent to an approximate shape of the gum. Into this place mixed plaster quite thin, gutta percha, or what is better than either, moulding composition (used by dentists for impressions). The two latter must be softened by hot water. Gently force this into position and retain it in place by a cork between it and the opposing teeth or, what is perhaps better, a piece of wood cut to fit both the metal

[1] "A Case of Fatal Hemorrhage from Extraction of a Tooth," by Richard Blagden, Med.-Chir. Trans., vol. viii., 1820.

[1] A Practical Treatise on the Diseases of the Teeth, by John Hunter, p. 92, London, 1778.

and tooth surfaces. The jaws are to be then brought closely together on the cork or wood, sufficient space being allowed for the passage of soft food between the teeth. Pressure is maintained by a bandage round the jaw and over the head and should be kept in operation for several days, the patient in the mean time being kept as quiet as possible. If the hemorrhage takes place between adjoining teeth, advantage may be taken of these and a plate made with clasps. This serves an admirable purpose, and has been found very efficient without annoyance to the patient. Where the opposing teeth in the other jaw are wanting, it may be difficult to keep up the compress-pressure by the mere closure of an edentulous jaw upon the bleeding alveolus. Mr. Higginbottom, of Nottingham, was, I believe, the first to invent what he called an *alveolar tourniquet*.[1] It is an instrument consisting of two blades or shafts, united at one end and capable of approximation and compression by means of a screw, and free at the other extremities; these latter are armed with pads, one applying to the compress in the mouth, and the other to the exterior; where the bleeding is in the lower jaw, the blades are nearly equal, the exterior one simply passing under the base of the horizontal ramus: for the upper jaw the instrument is less applicable and the outer blade requires a long curved sweep, so as to grasp the top of the head. Various local astringents have been recommended in conjunction with the lint-plug: matico has been highly spoken of. I have found an alcoholic saturated solution of tannin answer the purpose very well; but probably the old remedy, turpentine, has never really been superseded. [A saturated solution of alum is by some considered preferable and the most reliable of hæmostatics.[2] The persulphate of iron has been much used for this purpose, but, while its action is rapid in forming a clot, the danger of secondary hemorrhage is too great to permit its indiscriminate use.]

I am convinced, however, that it is a great mistake only to treat these cases topically: they are most obviously manifestations of constitutional vice, and require a corresponding general treatment. Astringents should be had recourse to at the earliest stage; they can do no harm, and may be suspended at any time, while in the majority of cases they will be most beneficial. These cases often extend over so long a period that constitutional treatment has abundant time to be brought into full operation. Tannin and turpentine have been the most successful of internal remedies in recorded cases; with the latter drug, steel might be advantageously combined, especially in the form of the muriated tincture. In the irritability of sanguineous exhaustion, opiates may become necessary in large doses.

Other circumstances require attention: the patient should occupy a cool apartment, and local icy applications may be beneficial. The upright posture is to be preferred: or if the patient goes to bed, he should be bolstered up in as elevated a position as possible, while the circulation in the lower extremities should be encouraged.

In women during the menstruating period of life, it should not be forgotten that the hemorrhage may be associated with suppressed menstruation, and constitute a vicarious discharge; and remedies should be adopted to meet this contingency.[1]

X. *The application of obturators and false palates in cleft palate, etc.*—The title of this section is scarcely in keeping with the heading of my essay—"Surgical Diseases connected with the Teeth," etc. The maladies which give rise to perforations and clefts of the palate are, practically speaking, very seldom dependent on diseases of the teeth; but the particular region of their resultant defects, and the nature of the mechanical dentist's art, as remedying those defects, bring this matter fairly within my province.

The two forms of cleft or perforate palate, congenital and induced, are very unequally suited to this particular plan of treatment: a large number of the former may be radically cured by means of surgical operation, which is always preferable where practicable; in the latter cases, the mechanical assistance of obturators is of more avail, and, in many instances, not only removes an existing defect for the time being, but is to a great extent curative.

In congenital cases, when *very* severe, this is the only method applicable for the treatment of the great physical defect, no operation being capable of bringing into apposition the separate masses on either side of the cleft, or of remedying the defect of soft parts, which consequently require to be supplied by new and foreign material.

When the cleft or perforation consists of an aperture in the hard palate only, as in most syphilitic and scrofulous cases, and some congenital, an arch of metal or other hard substance spanning over the

[1] 'On Arrest of Bleeding after Extraction of Teeth," by J. Higginbottom, F.R.S., Prov. Journ., vol. iv., 1842.

[2] Garretson, Oral Diseases and Surgery.]

[1] On the Hemorrhagic Diathesis, see vol. i., p. 450 et seq.

orifice, and firmly applied to the contiguous palatal surface, is all that is required. When, however, it extends backwards and involves a destruction of the velum palati, and that to an amount which cannot be remedied by surgical operation, it becomes necessary to add to the metallic arch an elastic flap (such as vellum or India-rubber), which will supply the mobile functions of the soft parts as they are when in a normal condition. The former apparatus may be styled *obturators*, the latter *false palates*. In not a few of these cases other portions of the upper jaw become implicated; the alveolar processes may be necrosed, involving the loss of the contained teeth and sometimes of considerable masses of bone. To replace these losses various combinations of obturators, false palates, and artificial teeth have to be constructed, and they may be made in every variety, the different parts being associated together to supply lost parts and to fit by close adjustment those that remain.

The materials of which obturators are made may vary; carved ivory, vulcanite (indurated sulphuret of caoutchouc), or flattened metal—gold, platinum, dental alloy, or silver—are all employed. The first, however, is now generally discarded, from its perishable nature. Vulcanite has been extensively adopted; but its thickness, and fragile character when very thin, militate against it in many cases. I much prefer sheet metal, on account of its strength, thinness, and durability. Silver, platinum, or dental alloy may be employed for hospital purposes; but gold is far better, and I am in the habit of using it, except in hospital cases. It is an object to have the sheet of metal as thin as possible without weakening it; and I employ the gold plate reduced to No. 6 of the gold-flatter's gauge, being somewhat thinner than is usual for the frames on which artificial teeth are mounted. This degree of tenuity is quite compatible with entire firmness, and it receives better all the inequalities of the rugous plate: when a plate of this thickness is perfectly adapted to the palatal arch, it is scarcely appreciable to the wearer. As long as sound teeth remain in the upper jaw to which the plate may be attached, it should be supported by means of clasps or collars embracing them; when these are lost, the same object may be achieved by connecting the obturators by means of springs with a frame resting on the lower jaw. Under no circumstances whatever ought support to be obtained either by dilating sponge, or by hooks, or other processes passing into the nasal cavity—the effect of which is to increase the size of the orifice, or prevent its natural tendency to contract.

The old and still very common method of treatment, consisting of a disc of metal with a piece of sponge attached to its upper surface passing into the nose, cannot be sufficiently reprehended: it is filthy in its nature, and most injurious to the unfortunate patient's future condition, as the pressure of the expanding sponge causes progressive absorption of the margin of the orifice to an unlimited

[1] Among the earliest surgical writings we find notices of mechanical appliances to repair lesions of the palate. The still common obturator, consisting of a metal disc supported by a sponge passing through the perforation into the nose, was invented by Ambrose Paré, an eminent French surgeon (Les Œuvres d'Ambroise Paré; à Lyon, 1541). These and analogous apparatus on the same objectionable plan, were alone employed until Bourdet devised others on correct principles (Recherches et Observations sur toutes les parties de l'Art du Dentiste, par M. Bourdet; Paris, 1767). Bourdet employed thin sheet metal in the form of a vault wholly within the mouth, attached to the teeth at the sides, and free from any projection into the nose; and he was aware that when thus treated the orifice would contract and frequently close. M. Pierre Fauchard appears to have been the first person who combined artificial teeth with an obturator (Le Chirurgien-Dentiste; Paris, 1786). M. Touchard published an account of an apparatus not only to supply teeth and palate, but also a large mass of upper jaw which had exfoliated. This was effected with ivory (Description d'un obturateur dentier présenté à la Société de Médicine de Paris; Paris, 1814). M. Delabarre was the first person who succeeded in supplying a soft as well a hard palate. He accomplished the former with sheet caoutchouc, as have nearly all his successors (Traité de la partie mécanique de l'art du chirurgien-dentiste, par C. F. Delabarre; Paris, 1820). But the greatest advance in the construction of false palates was made by Mr. Snell, whose apparatus was essentially the same as those employed in the present day (Observations on the History, Use, and Construction of Obturators, or Artificial Palates, by James Snell; London, 1824). The same principles have been carried out with slight modifications, by Mr. Stearns (Lancet, vol. ii., 1845, pp. 7, 260, 284, 310); and by Mr. Sercombe ("Cleft Palate; its Surgical and Mechanical Treatment," Trans. Odont. Soc., vol. i., London, 1858). Dr. Kingsley, of New York, has devised an ingenious arrangement which very firmly and effectually closes the cleft of the palate. It consists of a wedge-shaped plate of hard vulcanite with a soft velum, forced forward into the fissure, and resting by a ledge upon the nasal surface of the hard palate, thus reverting to the objectionable principle adopted previous to the time of Bourdet ("On the Treatment of Congenital Cleft Palate," by Dr. N. W. Kingsley, in Trans. Odont. Soc., vol. v., p. 195; London, 1865).

extent. Any plug kept in position by tight-fitting acts in the same manner. There is a preparation in the museum of St. Bartholomew's Hospital (ser. I., No. 232), of the skull of a person who lost a portion of the palate, probably by syphilis, and who obtained temporary relief by stuffing the oro-nasal aperture with a large cork, gradually adding to the size of the plug to meet the requirements of the ever-increasing orifice, till the whole of the hard palate had disappeared, the palatal processes of the ossa palati as well as those of the maxillæ being lost. The progressive absorption under this continually-advancing pressure had removed the vomer, the inferior turbinated bones, and the nasal wall of the maxillary sinuses. Such a specimen is an eloquent commentary on this reprehensible plan of treatment. I believe in no instance is it necessary to gain support by the passage of processes of any kind into the nasal cavity, either to wedge against the sides of the orifice, or to rest upon the nasal surface of the palate.

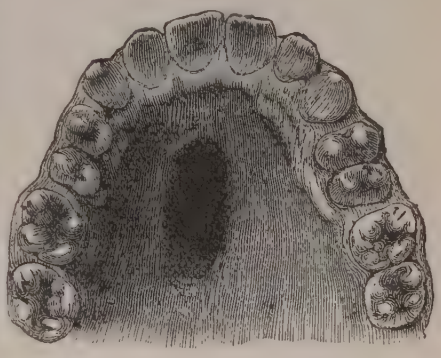
But an obturator passing over the perforation is not negative in its effect. An orifice which, allowed to remain open, may continue *in statu quo*, or contract in a degree scarcely appreciable, will often rapidly diminish in size when the passage of air and fluid between the oral and nasal cavities is prevented. This is not generally known or understood; but it is of great importance in treating these cases. The obturator should be applied as early as possible—as soon as the dead bone has come away, and while the wound is in a state of granulating activity. It is surprising how the granulations will stretch across the upper surface of the obturator, and close up the orifice; and, in more advanced and neglected cases, the same condition may be imitated to some extent by frequently scarifying the edges of the perforation, always taking care immediately to restore and keep in place a well-fitting obturator. Why the removal of the ill-*effects* of a perforate palate (passage of air and fluid from nose to mouth, and damaged voice), by means of mechanical appliance, should lessen or remove its *cause*, is not very apparent: it seems a curious transposition of events—an inverted sequence: perhaps the protection afforded by the plate to the granulating edge may to some extent account for it: it is, however, true, and very important practically.

Occasionally a portion of the floor of the antrum is lost by necrosis in cases of severe "abscess" of that sinus, and its cavity becomes common with that of the mouth, by an aperture of variable size. This orifice should be immediately closed, or rather spanned over, by a plate (upon which substitutes for the lost teeth may, or may not, be fixed), and the result will be, in many instances, the development of a membranous growth supplying the lost bone, completely scarring over the wound, and forming a floor to the sinus.

The exact nature and arrangement of the artificial appliances we are considering will perhaps be best elucidated by illustrative cases.

The accompanying figure (fig. 377) represents the upper jaw of a girl who has recently lost a portion of the hard palate from the effects of inherited syph-

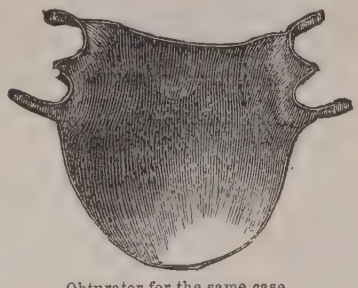
Fig. 377.



Perforation of hard palate by syphilis.

ilis. This cause is, I believe, unusual. I have not seen or heard of another case in which congenital syphilis has had such a result. The patient has suffered from characteristic keratitis, as well as from other symptoms of the disease. The loss of the bone was attended with all the customary conditions of suppuration and fetor, and after it came away a hole into the nose was left, as depicted in the woodcut. The patient's power of speech was seriously affected, and food and drink

Fig. 378.



Obturator for the same case.

passed into the nose. A few days after the bone came away, I took a model of the mouth, and an obturator plate was made as represented in fig. 378. The girl being an hospital patient, the metal

employed was "dental alloy," an alloy of silver and platinum, being less costly than gold. Support for the plate was obtained by collars passing between the bicuspids and first molars and the bicuspids and canines.

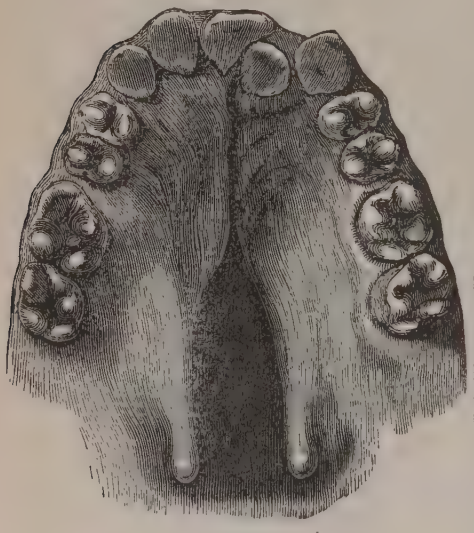
The application and fixing of the obturator *immediately* restored all the functions of the mouth: food was occluded from the nose, and articulation and enunciation were perfect.

This immediate restoration of the voice nearly always, I believe, occurs when *accidental* perforations of the palate are thus treated, and very soon, even where the soft palate is involved in a cleft and an artificial velum has to be supplied. But with congenital cases it is very different; and the patient has in them to commence a new oral education.

I saw this case again about three months after the introduction of the obturator; the hole had contracted to less than half its original size, and will probably close altogether.

The apparatus needed to supply the defects of cleft palate is more complicated, but is scarcely less satisfactory in its ultimate results. The accompanying figure (fig. 379) represents the upper jaw of a

Fig. 379.

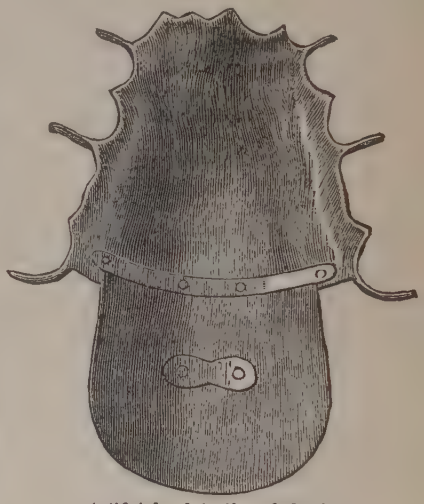


Cleft-palate.

young gentleman, now about seventeen years of age. He was born with cleft palate and hare-lip. The latter was operated on in early infancy with success; and it was intended that the cleft in the palate should ultimately have been closed by surgical operation; but the patient refused to submit to the pain. The cleft is complete from before backwards, passing to the left in the front of the mouth, an incisor being there wanting, as is frequently the case.

No difficulties were presented in adapting a hard and soft palate to occlude the cleft. A thin rigid gold plate was fitted to the hard palate, and support was obtained by clasps between the bicuspids and the teeth on either side, and to prevent the dropping of the hinder part, which is frequently troublesome, fine thin clasps extend round the back molars. The velum palati was replaced by thin soft vulcanized caoutchouc, which I always employ for this purpose. The accompanying illustrations (figs. 380, 381) showing the artificial palate as seen in face on the oral surface and in profile, render any lengthened description unnecessary. In adapting a soft palate it is necessary that

Fig. 380.



Artificial palate (from below).

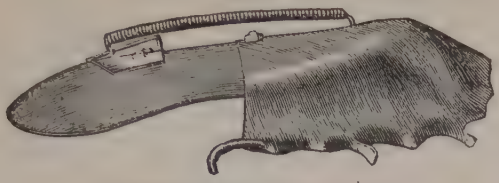
the movable flap should be kept constantly in apposition with the pillars of the fauces during their movements in deglutition, etc., and this is effected by means of an elastic spiral cord of gold wire, as seen in the profile illustration. This must be of the lightest possible character, as the power of the muscles to move the flap is very feeble. The same object is sometimes effected by doubling the thickness of the caoutchouc near the hard palate.

When a soft palate is first introduced, it often produces tickling of the fauces and retching; and it answers well to employ a very small flap at first, and gradually increase its size till it amply replaces the deficient velum.

When the flap is made of soft caoutchouc it becomes sodden in time, and loses its elasticity; but it is easily replaced,

and an intelligent patient may do this for himself. To obviate this objection, Mr. Parkinson,[1] who has had much experience in treating these cases, employs a thin flap of vulcanite; but this being stiff can hardly apply itself so closely to the

Fig. 381.



Obturator for cleft palate (side view).

pillars of the fauces; still, in effect, it is said to answer well.

In cases where large portions of jaw are lost from disease or accident, admirable restorations may be made, especially by means of vulcanite, and there is scarcely any part of the mechanist's art which tells with more effect on the patient's comfort. It is scarcely possible to put a limit to the variety and extent which these useful apparatus may reach.

[Apparatus for Congenital Cleft Palate.[2]

For many years past it has been maintained by many eminent surgeons in both hemispheres that the operation of Staphylorrhaphy, while it might be a perfect surgical success, does not benefit the patient; that however skilfully performed, there can be no certain expectation of improvement in speech, and therefore many of those who have achieved its best results have abandoned it altogether.

This abandonment of a method of treating congenital cleft palate, which appears to every one on the first observation as the most natural solution of the difficulty, has come partly from the discouraging results, and partly from the superiority of mechanism in the treatment of like cases.

When the anatomy and physiology of the *velum palati* as an organ of speech are studied in connection with the philosophy of articulate speech, it will be readily understood why the benefits from an operation are almost hopeless in every case, and why in a like number of cases the introduction of an artificial velum or an obturator may supply the functions of the lost organ.

Perfection of speech depends upon the management of the voice, not so much by the larynx or vocal chords, as by the organs with which the voice comes in contact after it leaves the glottis. The integrity of the pharynx and of the velum palati, both anatomically and physiologically, are essential to this result. For the perfect enunciation of certain sounds the muscular pharyngeal wall must contract and advance, at the same time that the palate is drawn backward and upward to meet it. With this perfect conjunction all the voice is then directed through the mouth, to be manipulated by the tongue, teeth, lips, etc. Perfect articulate speech is the arbitrary association of certain sounds with certain ideas, and all sounds produced by the normal action of any or all organs of the nasal and oral cavities enter into speech with some branch of the human family. All languages require not only that the nasal cavity must be completely shut off for some of the sounds as above described, but for the perfect enunciation of others the passage must be left open for the escape of a portion of the voice through the nasal cavity. This regulation of the direction and flow of the vocal current is still further modified by the palate and pharynx, by diminishing or increasing the nasal current in the production of some sounds.

With the loss of any portion of the palate, whether congenital or acquired, sufficient to make a permanent communication between the buccal and nasal cavities the perfect articulation of any spoken language is impossible.

In the English language, spoken with a defective palate, the sound of D approximates to the sound of N, that of B to M; K and G become impossible, except under very peculiar conditions; and S, T, and Ch become difficult and sometimes impossible. Besides, the resonating tone-character of both buccal and nasal cavities becomes entirely changed by their partial or complete union, or by the change in their form and dimensions.

From these various causes the speech of people so afflicted becomes altered in tone, indistinct in its enunciation, wanting in many of its sounds, difficult and sometimes impossible to understand, and altogether disagreeable.

[1] "On the Adaptation of Artificial Palates," Lancet, vol. i., 1867, p. 41.

[2] Prepared by Norman W. Kingsley, M.D., D.D.S., late Prof. of Dental Art and Mechanism, New York College of Dentistry.

The only evil arising from congenital cleft palate which demands the interference of science and art is this impairment of speech.

The operation of staphylorrhaphy has been a failure and must always be a failure, because—the defect being of congenital origin—there is an absolute want of tissue, nor can tissue be created to fill the gap. The fissure can be bridged over, the edges can be brought together and united, as has been done repeatedly, clear down to and including the bifurcated uvula, but in every such instance the newly-formed palate, while deficient in muscular activity, was deficient also in length, and no possible effort on the part of the patient could enable him to form a conjunction with the pharyngeal wall and thus produce perfect articulate speech. The restoration of speech to a person who has once possessed that faculty and lost it through a destruction of the palate, is comparatively easy; but to confer the faculty of perfect speech with an artificial organ, upon one who has been afflicted from birth with the absence of the natural organ, and has grown to maturity without the ability of distinct utterance, is a much more difficult problem. In acquired lesions even crude appliances, made without much skill or accuracy, are often very beneficial, while in congenital cases the full resources of science and the nicest adaptations of art are needed to accomplish the desired result.

The partial destruction of any organ of speech may occur after the acquirement of speech, and nature makes an extraordinary effort to overcome the difficulty by a new use and activity of other organs which in a measure supply the deficiency. Thus, the total loss of speech would follow the destruction of the hard palate, but an instant restoration would result upon the introduction of an obturator.

But in a congenital case the faculty of perfect speech must be acquired by practice, even after the introduction of the most skilfully constructed and scientific appliance. In a description of the treatment of the secases, the two classes and the different conditions above referred to must be kept distinctly in the reader's mind.

All apparatus adapted to the roof of the mouth, whether forward or back, to the hard or soft palate, may properly be designated as *artificial palates;* but as such instruments may be divided into two distinct classes, operated upon different principles, and applied in the main to entirely different cases, without the possibility of interchange of principle, I therefore denominate the one an *obturator*, and the other an *artificial velum.* An obturator, according to this distinction, is a stopper, plug, or cover, hard, non-elastic, and stationary, fitted to an opening with a well-defined border or outline, and shutting off the passage.

Such instruments are of nearly universal application to perforations of the hard or soft palate resulting from accident or disease, but they are rarely applicable to a congenital fissure of the velum. An artificial velum is not a stationary stopper, but an elastic movable valve, under the control of the surrounding and adjacent muscles, closing or opening the passages at will, and is applicable especially to congenital fissures; occasionally where the soft palate has been destroyed, but never to perforations of either the hard or soft palate.

The principles involved in the introduction of an artificial velum are directly opposed to the practice of staphylorraphy.

In the surgical operation the tensor, levator, and other muscles are divided so that the edges of the fissure may be relaxed and brought into contact. This division of the muscles weakens or destroys their power of action, and the result after a closure of the fissure is effected is a rigid, tense, and dormant septum in place of a muscular and active valve or palate.

In the normal condition of cleft palate the *levatores palati* are very active and the edges of the fissure are constantly drawn backward and upward by their movement.

In the introduction of an artificial velum this activity is not interfered with, but is made available by so constructing the apparatus that it shall embrace the sides of the fissure and thus be moved up and down by the levatores.

It was the recognition of these principles, more than twenty years ago, which induced the writer to experiment upon such cases, and in the beginning of 1860 he introduced such an appliance in a case of excessive deformity, which enabled the wearer to articulate every sound of the English language correctly and distinctly.

Artificial Vela for Congenital Fissure of the Palate.

Fig. 382 represents the model of an upper jaw with a fissure of the soft palate only.

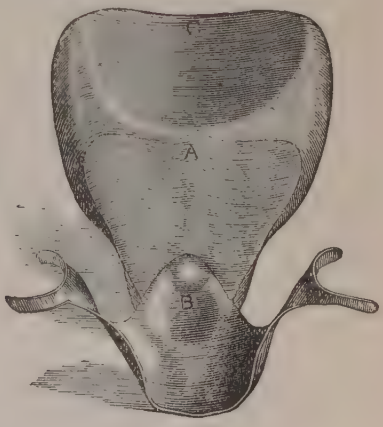
Fig. 383 shows the apparatus applied to it. Letters A C show the artificial velum, which is also represented by the dotted line in fig. 382. Letter B shows a gold plate which crosses the roof of the mouth, is attached to the natural teeth, and which supports the velum *in situ*—without this attachment it would slip down the throat. The velum is made of soft elastic vulcanized rubber, especially prepared to insure purity and durability. The portion

marked A bridges across the inferior or lingual side of the fissure, while the broader and posterior flap marked C bridges the fissure on the naso-pharyngeal side. When in use the sides of the fissure, together with the bifurcated uvula, occupy the separation between the laminæ A and C, and provision is thus made

Fig. 382.

Cast of a case of cleft palate.

Fig. 383.



Obturator with artificial velum.

for the contraction of the fissure or the approach of its sides, as in swallowing. The posterior flap C, being broad as well as elastic, is carried upward and backward by the *levatores palati*, and when of the proper length and adaptation, contact with the pharyngeal wall can be effected. By this means the action and function of the natural velum can be simulated. This drawing (fig. 383) represents an appliance

Fig. 384.

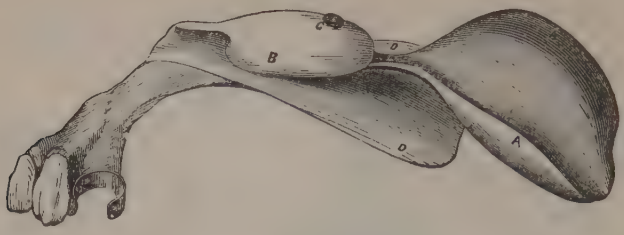
Cast of a case of fissured velum.

which was adapted to a young man then about 17 years of age, who is now taking part in public life, frequently addressing large audiences, and whose speech is so free from every trace of a defect that no one suspects his deformity. Fig. 384 repre-

sents a model of a fissured velum which was complicated with fissure of the hard palate, the alveolar process, and hare-lip.

The apparatus for this case was adapted upon the same principle as the other, and is shown in fig. 385. The fissure

Fig. 385.



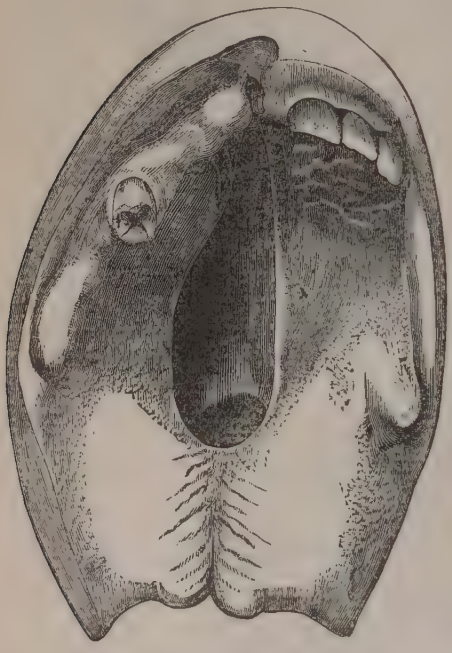
Apparatus for fissured velum.

in the roof is here filled by the plate to which the velum is attached. Two artificial teeth are also upon the plate.

Fig. 386 shows the model of a case in which a successful operation upon the palate had been performed when the patient was sixteen years of age.

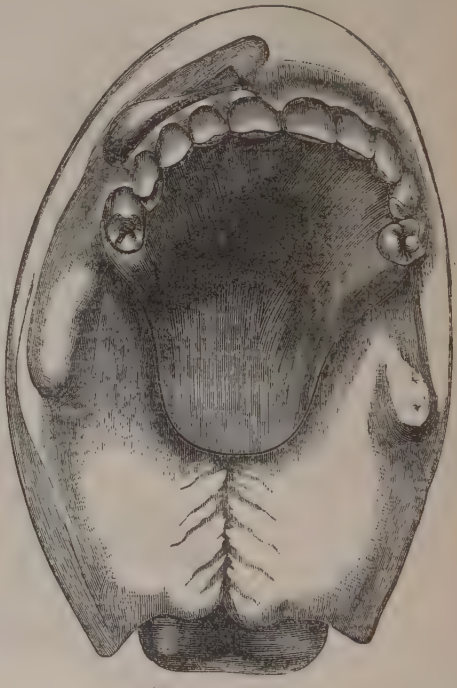
The hole in the hard palate left after

Fig. 386.



Cast of a fissure of the hard palate.

Fig. 387.



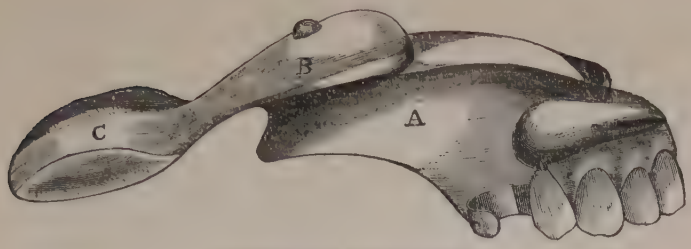
Obturator applied.

the operation, was bridged over with an obturator. For ten years the patient vainly tried to improve her speech, and then came to me for relief. Here was an excellent illustration of the uselessness of staphylorrhaphy.

The surgical operation upon the palate was a complete success, but speech was in no wise improved.

The apparatus shown in fig. 388 was made and adjusted. The principle involved was simply an extension of the natural palate to enable it to meet the pharyngeal wall. The extension marked c was introduced by passing it into the opening in the hard palate and extended beyond it as shown in fig. 388. This extension was sufficient to shut off the escape of sound and enable the patient to improve her articulation. In two other cases which have come to me where the entire fissure was closed by surgery with-

Fig. 388.



Obturator with artificial velum.

out benefit after a number of years' trial. I have cut an opening through the palate at about its junction with the palate bone, and have thus introduced an artificial velum similar to the last one described, and with most encouraging results.

Obturators for Congenital Cleft Palate.

The appliances thus far described have been based upon the principle that the best results are obtainable only by copying and imitating as far as possible the form and movements of the absent organ.

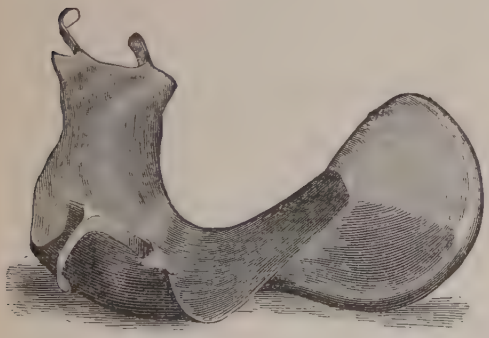
A very different principle has been followed in some instances with marked success.

The idea that the *best* results can be obtained by an imitation of the movements of the natural organ is based upon sound philosophy, but it does not take into account the physiological fact that often we find that loss of muscular power or partial loss of organs does not always necessarily destroy function; another set of muscles may be educated or trained to new uses and produce similar if not exactly the same results.

The success of an artificial velum depends upon both the action of the levatores palati and the constrictores pharyngis.

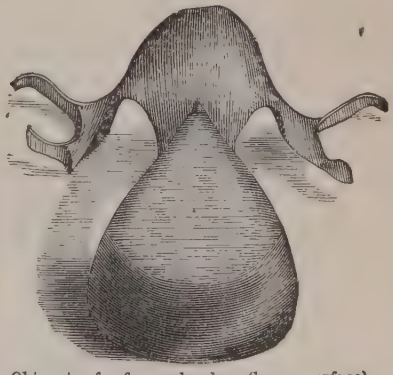
In 1867 Dr. William Süersen, a German dentist, described an obturator for congenital cleft palate, the success of which depended entirely upon the activity and control of the pharyngeal muscles. It was so constructed that when the pharynx was in repose, there was ample room behind the obturator for the passage of nasal sounds; but when the nasal passage was to be shut off it was to be accomplished by the contraction of the pharyngeal wall into close contact with the posterior end of the obturator.

Fig. 389.



Obturator for fissured velum (side view).

Fig. 390.



Obturator for fissured velum (lower surface).

Experience has proven that this was not an unfounded expectation, and that in some instances quite perfect results have been obtained.

The accompanying figures, 389 and 390, show two views of such an instrument which the writer substituted for an artificial velum for one of his own patients, and with complete success; but it was in a case where the patient had learned first to articulate distinctly with the artificial velum. The case became analogous then, to that of one who, possessing perfect natural organs of speech and speaking well, suddenly loses that faculty by some acquired lesion of the palate (syphilis for example). The introduction of the most simple obturator then immediately restores the faculty of speech, while the *obturator* applied *first* to the *congenital*

cases, rarely enables the wearer to learn to speak perfectly.

The peculiarity and effectiveness of the Süersen obturator, as shown in figs. 389 and 390, lies in the bulb which is formed to fill the chamber of the pharynx when that organ is constricted; and of all obturators ever constructed for *congenital* fissures, this is the only one which possesses any scientific or practical value.

Results of the use of Artificial Palates.

Much misapprehension exists in relation to the benefit derived from the introduction of an artificial palate by those who have but a partial knowledge of the subject.

Exaggerated statements are not unfrequently made by interested persons of the marked improvement in speech following immediately upon the introduction of such an apparatus. In the nature of things there is no ground for such an expectation. In an experience with such cases, probably larger than that of any other practitioner, and covering a period of over twenty years, the writer has never seen an instance of marked immediate improvement in a congenital case from voluntary effort.[1] Articulate speech is not a natural function, but a mechanical one, which must be acquired by imitation and practice; and all analogy shows the difficulty which any one arriving at years of maturity finds in breaking up bad habits of speech and forming new ones, or in acquiring perfectly a foreign language.

With the most perfect artificial organ possible, the wearer must learn to make the theretofore defective sounds properly, and then apply the acquirements to his continuous speech. He will derive much benefit from one skilled in teaching articulation, or from any person who will intelligently criticize his efforts. Under such training a single hour has in some cases developed marvellous results.

Without practice and perseverance, expectations of improvement are groundless. With such application and determination there are now many such people who are speaking so perfectly that an artificial organ is never suspected.

From the above it will readily be inferred that cases treated early in life are more promising than those of adults or advanced years. Probably the best age, all things considered, is from twelve to fifteen; but at whatever age, no hope of benefit can be legitimately expected from an instrument introduced by one with no knowledge of the mechanism of speech, without experience, and without a recognition of the peculiarities of each case which may require special apparatus.]

DISEASES OF THE INTESTINES.

By George Pollock, Esq.

Revised by J. Henry C. Simes, M.D.

Abdominal Abscesses.

Abscess originating in the substance of the anterior abdominal wall, or in the sub-peritoneal cellular tissue, in the region of the loins, or pelvis, and totally unconnected with disease of bone, or with ulceration of the bowels, is not a very common occurrence; but as we occasionally meet with such a case, it is requisite to allude to its peculiarities and treatment.

An abscess confined to the substance of the muscular parietes is most frequently the result of a bruise, and may be treated as abscess in any other position. [Erichsen advises that "these abscesses should be opened early, lest they burst into the peritoneal cavity, and occasion fatal inflammation."] But one commencing in the cellular tissue of the loin, or iliac region, is generally obscure in the commencement; frequently produces much constitutional disturbance in its progress; and is very often fatal in its results. Abscesses occurring in these situations are sometimes slow in formation; but in other instances form with great rapidity, and acquire a large size within two or

[1] The reader must not lose sight of the contrast already alluded to, in this respect, between congenital and acquired lesions.]

three weeks. According to the rapidity of their progress will be the acuteness of the symptoms which accompany them. They are as frequently seen in children as in adults. Without careful examination, they may be readily mistaken for psoas abscess dependent on diseased vertebræ, or for some kind of tumor growing in the cavity of the abdomen. In children, from the resistance of the abdominal and psoas muscles, and the drawing up of the thigh on the belly, disease of the hip-joint might be suspected, if the conditions be not particularly examined into.

A very sickly child was admitted into the Hospital for Sick Children, under the care of Sir W. Jenner, with a large prominent roundish swelling on the left side, between the region of the kidney and Poupart's ligament. There was very little indication of pus, or fluid, in the swelling; its shape and consistence conveyed the impression that it might be a malignant growth. As some doubt existed as to its character, a fine trocar was passed into it by the writer, and some thick pus immediately escaped through the canula. A small opening was then made through the parietes into the abscess, and allowed the free escape of pus. The child very shortly recovered.—A child was admitted into St. George's Hospital, with much swelling and great tenderness about the left iliac fossa; the thigh was bent on the body, and kept drawn up; any attempt to extend it was attended by great pain; so much so, that it was impossible, on account of the struggling and crying of the child, to make out the extent or the seat of the mischief. Chloroform was therefore administered; under its influence the thigh was readily extended, and the mischief found to be confined to the iliac fossa. Here was a swelling of some extent, and all the tissues over it thickened and hardened; the skin was darker colored and more red than natural. Though fluctuation could not be detected, a small incision was made over the most prominent point, and cautiously extended to some depth; but, as no pus escaped, exploration was not carried farther, and a poultice was ordered to be applied. On the second day, a sudden flow of pus took place through the wound; relief to all the urgent symptoms followed; and the child recovered shortly.

Acute and large abscesses occur in the sub-peritoneal cellular tissue about the region of the ovaries after the period of childbirth. For an account of them, and their treatment, we must refer the reader to Vol. I., p. 341.

Abscess in the abdominal region is often connected with an artificial aperture in the alimentary canal, either stomach or intestine. Such an abscess may arise from perforation of the bowel, the result of simple ulceration; or the lodgment of any foreign body in the intestine; often from ulceration, set up in the gall-bladder by a gall-stone; or from stricture of the intestine; and most frequently from some cancerous disease of the alimentary tube.

When such an abscess occurs, its contents will generally consist of pus and feces mixed together; but occasionally the opening in the bowel has been so small, that very little of its contents have escaped; sufficient, however, to set up the secondary mischief. When the abscess is opened, the escape of mere pus alone does not justify an opinion that the bowel neither is, nor has been, implicated. It will happen occasionally, some days after clear pus has been discharged from the opening, that feculent matter is observed for the first time to be coming away with the discharge. As the walls of the abscess contract, they probably have disturbed the former attachments of the intestine, and thus facilitated the renewal of an escape of its contents.

Abscesses connected with the bowel cannot be said to follow any definite rule, either as to symptoms, rate of progress, or termination. They may be obscure in their commencement, and in their progress, or marked by violent pain; while the medical attendant may be daily watching for an opportunity to give exit to pus at some favorable point, the swelling may suddenly subside, and disappear by evacuating the contents, through some fresh opening, into the bowel, the pus being discharged per anum.

When of an acute character, the symptoms of a "fecal abscess" are very marked. Sudden pain is referred to the part affected, often of a very severe character; constipation often anticipates the attack, or accompanies it. The pulse and tongue sympathize early in the mischief; the former becomes rapid; the latter loaded and creamy, and soon dry and brown. There is often great anxiety and restlessness; much thirst, and a hot dry skin. There is very frequently, early in the attack, distinct fulness of the part implicated; and, in addition to extreme tenderness and an intolerance of pressure, general indications of diffused peritoneal inflammation. The most frequent seat of such abscesses is the region of the ileo-cæcal valve—the right iliac fossa; but they may occur in any part of the abdomen.

Sometimes the formation of pus is so rapid, and the mischief in the peritoneal cavity is so general, that the patient dies within a few days of the first symptom of pain. Mr. ——, late House-Surgeon of St. George's Hospital, while walking in Hyde Park, was suddenly seized with excruciating pain about the right iliac fossa. Though but a very short distance from his lodgings, he was obliged to be carried home. When seen by the author in the evening, there was intense pain in the right

iliac region, with a certain amount of fulness, and great tenderness on pressure. The skin was hot; the pulse rapid; and there was great anxiety of countenance. The symptoms were in no way relieved by the treatment prescribed in consultation with the late Dr. Bright. The case proved fatal in a few days. On examination after death, a large abscess was found to occupy the right iliac fossa; the boundaries were formed by adhesions of the intestines and the parietal peritoneum. The contents were pus and feces. The appendix cæci was found ulcerated through at its extremity. No solid substance could be found to account for the ulceration by its pressure or in any other way.

It is desirable to note that when abscess is the result of an ulcer perforating the wall of the cæcum, much will depend on the exact seat of that ulcer; viz., whether it be in the part covered by peritoneum, or on the posterior surface where the intestinal wall is in contact with cellular tissue. In the former instance, such an abscess is frequently rapidly fatal from the immediate effects of acute peritonitis: or adhesions of the opposed peritoneal surfaces may have occurred prior to the perforation, and the abscess become limited by such adhesions, and after a time present externally; the patient then has more chance of recovery after the evacuation of the pus. In the other instance, in which an abscess is the result of perforation of the posterior wall of the intestine, and the escape of fecal matter into the cellular tissue, the abscess is less apt to be limited; and matter often burrows in a variety of directions.

A woman, lately admitted to St. George's Hospital under the author's care, had extensive suppuration and numerous sinuses with various openings in the right groin and on the outer surface of the right ilium. These were freely laid open, but she gradually sank exhausted. On examination after death, a circular smooth-edged small opening was found in the wall of the posterior surface of the cæcum, communicating with a large abscess in the right iliac fossa, and with numerous sinuses running in various directions. The ulceration appeared to be due to an attack of fever.

Occasionally an abscess in this neighborhood is much more tardy in its progress; and although matter continues to collect, the patient, having passed over the first acute stage of the attack, may soon improve in health and appetite; the general tenderness of the abdomen, or distension of the bowels—should either have existed—commences to subside; and a local swelling remains in some portion of the abdomen, marked by external fulness, and often by a well-defined surrounding wall. The skin over this part becomes more red and shining than that of the immediate neighboring surface; then darkens in color, and becomes thinner at one or more spots; and either ulcerates or is punctured, when pus readily escapes.

It is a safe and very judicious proceeding to open such an abscess, as soon as it may be suspected to have formed, and to be within reach of the knife. If the incision be delayed until matter makes its approach towards the surface, it will generally happen, during this process towards self-liberation, that the pus works its way in several directions; it has been so long kept back by the resisting action of the abdominal muscles and fasciæ, that it has burrowed wide and deep: so when the external opening has been long postponed, by nature or the surgeon, we find, in addition to the suppurating cavity in the iliac region, that the abscess has passed under Poupart's ligament and among the adductor muscles of the thigh, or deep into the pelvis, and may present itself in the perineum, or has even opened into the rectum or vagina. We can never define what bed these abscesses may form for themselves, or how, when, or where they will discharge their contents. If one be opened late in the progress of the case, long sinuses will often be found, which lead from the opening in the abdominal wall to the surrounding parts, and thus render the ready escape of matter difficult. Under such circumstances, after a time, other collections of matter point, either in the groin, in the thigh, or about the ischiatic rami. Many a patient will, however, sink soon after the opening of a fecal abscess: not only has he to contend against the effects of profuse discharge, but he has also the extra evil of a too ready and early escape of intestinal contents from the opening in the bowel.

Notwithstanding the severity of such cases in their general aspect, and the frequently fatal results they entail, we occasionally find a patient gradually recover, as it were, from a bed of death, and after he has endured the opening of a great number of consecutive abscesses; the sinuses slowly contract; the discharge diminishes by degrees, and ultimately ceases; and the orifices of the abscesses cicatrize one by one. The patient however, recovers with a crippled limb, as a general rule. The suppurative action usually implicates the psoas and iliacus so much, and often the adductor muscles, that the movements of the thigh are subsequently restricted, nor can the limb be extended to its natural limit.

The general treatment of this class of cases is not to be laid down as simple, nor conveyed in a few words. It depends entirely on the course of the case.

In the early stage, *i. e.*, of pain, constipation, and fever, constitutional measures and local treatment must be combined. Opium internally, and hot fomentations, perhaps leeches, externally, are usually most beneficial at first. Opium may be given in full doses, and often repeated. It may be requisite to combine small doses of calomel with it. Purgatives, as a rule, should be strictly avoided. Under the influence of opium alone, or combined with calomel, the bowels will act as early as their condition will permit; and quite soon enough to answer nature's purpose, *if they will act at all*, without the aid of purgatives.

When the patient survives the shock of the attack of inflammation, so soon as matter is suspected, the part should be explored, and, if possible, the pus let free. Under the influence of chloroform [or ether] alone, can a satisfactory examination be made, in a case such as we are now considering, and we would, under all conditions which indicate, though they do not absolutely prove, the presence of pus, urge the use of chloroform, that a thorough examination may be instituted, and exploration made if deemed advisable.

Great attention and care in treatment is necessary, as soon as the pus has an outlet. Strict cleanliness is requisite, to prevent excoriation from the discharge, and also to avoid bed-sores. As the discharge is often extremely offensive, the chamber becomes insufferable, if not constantly and carefully ventilated. A free use of disinfectants is requisite in the room, as well as in the local dressings. A constant and liberal supply of nutritious food and stimulants are wanted to meet the wasting and lowering effects of profuse secretion from the abscess. It is often surprising to observe the quantity of wine patients require, and will take with impunity, under these conditions. The bowels must be carefully watched; they are often apt to become relaxed, and this diarrhœa, if unchecked, tends to reduce the patient. If collections of matter should point in other parts, they ought at once to be let out; or if superficial sinuses lead from one abscess to another, they should be slit up.

The usual conditions found after death, in cases of fecal abscess, are general adhesions of the intestines and viscera in the immediate neighborhood; some portions of which may form the boundaries of the abscess-wall. The communication with the intestine is generally very clear; often several may be observed; but when more than one exists, the others are commonly the result of ulceration *from* the abscess *into* the gut.

Most commonly the mischief which produces fecal abscess, independent of cancer, arises near the ileo-cæcal valve: ulceration of the appendix is one of the most frequent causes.

["The cæcum and vermiform process are often the seat of diseases which lead to circumscribed peritonitis. The connective-tissue, also, which lies behind the cæcum over the iliac fascia, is sometimes the seat of inflammation and abscess. The two first mentioned processes are from the outset intra-peritoneal, while phlegmonous inflammation in the areolar tissue behind the cæcum is first retro-peritoneal, but frequently involves the peritoneum, and may secondarily extend to the intestinal wall. These inflammatory processes are therefore anatomically distinct in their position, and they also possess from the outset a different significance and importance; nevertheless they present in their symptoms so much uniformity that the clinical distinction between them is in the majority of cases impossible. We must frequently be satisfied with recognizing the inflammation in the right iliac fossa without distinguishing whether the cæcum, the vermiform process, or the retro-peritoneal areolar tissue, be the starting-point. In many cases, furthermore, the distinction is impossible, it being at the same time, however, a matter of no practical importance, owing to the fact that the forms of inflammation mentioned pass into one another, so that by an ulceration of the vermiform process the cæcum becomes involved.

"Circumscribed peritonitis which attacks the serous coat of the cæcum and its neighborhood is most frequently due to an accumulation of feces (typhlitis stercoralis.)"[1]

In an excellent paper, by Dr. Henry B. Sands,[2] "on Perityphlitis," giving the history, treatment, and result of twenty-six cases, he makes a division of the cases as follows:—

"1. Cases terminating in resolution, without evidence of suppuration.

"2. Cases of abscess, terminating in spontaneous recovery.

"3. Cases of abscess, treated by operation.

"4. Cases of abscess, unopened, and ending fatally.

Those of the first division were diagnosed by sudden abdominal pain, usually most marked in the region of the cæcum, a high temperature, 100° to 104°F., pulse accelerated, and the presence of an indurated swelling in the right iliac fossa; this swelling was recognized either by palpation in the right iliac fossa, or by digital exploration of the rectum. In all instances the tumor was deep-seated, immovable, and tender on pressure. Their treatment consisted mainly in local depletion, fomentations, or poultices to the

[1 Bauer, Diseases of the Peritoneum. Ziemssen, Cyclopædia of Medicine, Amer. ed.]

[1 Annals of the Anatomical and Surgical Society of Brooklyn, New York, July, 1880.]

abdomen, and opium internally. Early in the disease a mild purgative was given; this treatment by a mild laxative was adopted for two reasons, as an aid in diagnosis, by excluding fecal impaction in the cæcum, and because the accumulation of fecal matter in the cæcum increases the patient's suffering, as well as aggravates the existing inflammation. When absorption was unusually slow, blisters and mercurial applications were resorted to.

The second division, or cases of abscess, terminating in spontaneous recovery, are, from Dr. Sands's experience, possible, since in two instances the abscess ruptured into the intestine, and in a third it was very probably discharged through the bladder. The prognosis in these cases is very favorable, convalescence beginning immediately after the abscess has ruptured.

Cases of abscess treated by operation.—This group contains eleven cases. In all a tumor was discernible in the iliac region. In four fluctuation was obtained. Pus was indicated in the remaining seven cases by "rigors, sweating, high temperature, acceleration of pulse, abdominal pain and tympanitis, and an increasing extent combined with diminishing firmness of the abdominal tumor. But none of these signs is invariably present, and it would be a difficult matter to say which one of them is the most important."

The method of opening the abscess adopted by Dr. Sands, is essentially the same as that first recommended by Dr. W. Parker. An incision, parallel to Poupart's ligament, is made through the skin and subcutaneous fat, over the most prominent part of the tumor. The deeper parts are then divided until the transverse fascia is reached. If fluctuation is evident, the abscess is immediately opened; if not, an exploring puncture, by means of a hypodermic syringe, is made through the fascia, until the abscess is discovered, when the operation is completed by passing a bistoury alongside of the needle into the abscess. Dr. Sands advises that the external incision should be two inches long, and should grow narrower as it increases in depth; the direct opening into the abscess being large enough to admit the finger, which latter should be inserted in order to ascertain the presence or absence of any foreign body.

In opening perityphlitic abscesses, in which fluctuation cannot be obtained, Dr. Sands recommends caution—

"for fear of wounding the peritoneum or the intestine; but I am doubtful whether such caution is absolutely necessary. Whether in consequence of the fact that these abscesses contain gas, or because they are adjacent to the intestine, they often yield a tympanitic sound on percussion, giving one the impression that the intestine is close at hand. But I have never observed this to be the case on opening the abscess, which is frequently so large that the forefinger inserted into it can barely touch the cæcum, displaced from its normal position towards the median line."

In all doubtful cases it is advised that the aspirator be invariably employed to guard against accident.

In the fourth division we have abscesses terminating fatally without discharging their contents either internally or externally. This group includes but two cases of Dr. Sands's table; one of the patients died of peritonitis, and the *post mortem* revealed a large abscess behind the cæcum and ascending colon. Although the abdomen was greatly distended, no tumor could be discovered in the iliac fossa, or in the rectum, previous to death. The second case also presented upon examination no tumor. The patient developed cerebral symptoms, and died on the sixteenth day. The *post-mortem* examination showed purulent meningitis, which seemed to be pyæmic, for an abscess was found in the lumbar region of the abdomen behind the cæcum and colon.]

In the Transactions of the Pathological Society (vol. vii., p. 210) is recorded a case in which perforation of the cæcal appendix was occasioned by the impaction in it of an intestinal concretion. Another case is detailed (vol. xii., p. 85) in which a fistulous orifice in the abdominal parietes opened into a circumscribed cavity, which communicated with the interior of the colon and duodenum, and indirectly with the gall-bladder. This was probably the result of a gall-stone ulcerating into the duodenum, and accidental rupture of the colon.

Fecal abscesses and fecal fistulæ occur in other parts of the abdominal wall: they are most frequently connected with the large intestine, and are generally the result of some cancerous obstruction, attended by ulceration of the bowel above, which, extending to the integuments, allows a partial escape of feces.

A case of fecal abscess and fistulæ communicating with the cæcum, caused by cancerous disease of the large intestine, is recorded in the Transactions of the Pathological Society, vol. i., p. 265; another, of abscess in the abdominal walls in connection with cancer of the stomach, vol. xi., p. 122; and a third, of fistulous openings through the abdominal parietes communicating with the transverse colon and stomach, the result of cancerous disease, vol. viii., p. 221.

The treatment of fecal fistulæ dependent on cancer does not call for much remark. The patients often linger much longer than might be expected, provided

they can take plenty of nourishment; but they often succumb much more rapidly than is anticipated by those in attendance; it is therefore best to warn the relatives of the sufferer of the possibility of sudden collapse in this disease.

Intestinal Obstructions.

The causes of intestinal obstruction are so various; its occurrence is fraught with so much danger; its symptoms are so severe and distressing; its diagnosis is so obscure; and its treatment so uncertain, and so often unsuccessful, that it is with the greatest diffidence we undertake the consideration of such an important subject as the pathology and the symptoms of intestinal obstructions, and the measures to be employed for their relief.

In entering upon an inquiry beset with so many difficulties, it has appeared to us a very important point, at the outset, to endeavor to classify the causes of obstruction, so that, in some measure, we may be able to determine, according to the symptoms, whether the obstruction depends on an acute strangulation entailing great and imminent danger to life; or on a slowly altered condition of the intestine itself, or of the adjacent tissues. Under the first condition the treatment must be decided; and to prove effective, must be early applied. In the second, there is generally more time to consider the prospects of life, and the advantages of interference. In the first, without prompt and entire relief, death generally follows rapidly in the wake of the onset of the symptoms. In the second, while we are calculating our measures, the symptoms may even subside; and their sudden cessation be followed by perfect recovery.

We therefore propose to divide the causes of obstruction into, 1st, those we may term sudden; such as are productive of acute and rapidly fatal results, if not presently relieved: and 2d, those more slowly acting; productive of symptoms, chronic when compared with the first; and such as sometimes subside with the aid of medicine alone, or even occasionally without it.

Those which generally produce most acute symptoms, early in their attack, sudden in their nature, and rapidly fatal in their results, comprise,—

1. Congenital strictures, or malformations.
2. Foreign bodies impacted in the intestines, and introduced through the stomach; formed in the gut; or escaping by ulceration, from the gall-bladder.
3. Twisting, or "dislocation," of the bowel—most frequently observed in the large, but often in the small, intestine.
4. Loops, formed by bands of false membrane, adherent at both extremities; by diverticula, adherent by their apices to some portion of the viscera or abdominal wall; or by the fimbriated processes, or other portions of viscera; contracting adhesions, so as to form rings, or apertures, for intestine to become entangled in—all these usually the result of peritoneal inflammation.
5. Mesenteric pouches; foramen of Winslow; or "thickened peritoneal sheaths,"[1] the result of old herniæ.
6. Invagination — often caused by worms, intestinal polypi, etc.

It is hardly necessary to mention, that all forms of external hernia are excluded in this consideration.

The more slowly acting processes productive of obstruction, in which the symptoms are at first not urgent, and in which relief sometimes occurs without assistance, and occasionally when all hope of life may have vanished, are—

1. Constipation, habitual or accidental.
2. Inflamed, thickened intestine, the result of injury.
3. Chronic peritonitis (tubercular) and abscess.
4. Tumors pressing on the bowel—hydatids, etc.
5. Simple stricture of intestine, the result of ulceration and other causes.
6. Cancer of the bowel, producing contraction of the gut.

Although we have divided these usual causes of obstruction into two classes, each productive of its peculiar train of symptoms and effects, one of the acute character, the other of a chronic nature, yet it must be clearly understood, for it will certainly be found so in practice, that this division must only be taken as a mere outline map of the difficult country we have to explore; that in many cases the symptoms may subside from the acute into the chronic, or from a quiet state become very severe. It must not be taken as a fact in every case, that acute symptoms cannot, or do not, depend on any one of the latter causes of obstruction; or a more chronic state of symptoms on any of the conditions noted in the first division; but as a general rule, we may venture with some degree of assurance to assert, that the several symptoms which will mark the cases coming under our first division are urgent, acute, and rapidly result in collapse and death, if not relieved by nature or art; while the greater

[1] Rokitansky's Pathological Anatomy, vol. ii., p. 59.

number comprised in the second division are attended by symptoms which come on by degrees, may last many days, often weeks, or even months in some cases; are generally by so much the less urgent than the former in character, and permit of delay in treatment as regards surgical interference; allow time for consultation; are often capable of medical relief; and, if surgical treatment be considered requisite, offer many more features favorable towards the prolongation of life, than do the acute cases of obstruction. It must be borne in mind, that constipation, or entire stoppage of defecation, is not an absolutely requisite symptom to indicate fatal obstruction of the intestine; nor, in suspected organic obstruction, should we presume to say that the disease has yielded to our treatment, even though diarrhœal action of the bowels comes on; it will probably last but for a short time, or the quantity of fluid passed will be small in proportion to the frequency of the motions. A relaxed state of the bowels in stricture is usually indicative of ulceration, and may occur, in old contracted stricture of the intestines, within a very short period of death.

1. Congenital malformations of the intestinal canal, giving rise to immediate obstruction, are almost entirely confined to the rectum and its external aperture. These deformities, and their treatment, will be found described in the essay on THE SURGERY OF CHILDHOOD, and therefore require no further notice here.

Another, but very rare condition of stricture, has been occasionally found in the duodenum of infants; the two following cases illustrate these structural alterations.

A child, when born, presented no unusual symptoms for the first twenty-four hours; vomiting then came on, and continued, with short intermissions, until death, which took place some thirty-eight hours after birth. The bowels were never relieved during life. The only disease found was a stricture of the duodenum, close to the entrance of the gall-duct; so that a probe passed down the latter entered the duodenum immediately below the constriction. There was nothing to indicate in what manner the constriction had occurred. On the gastric side of the latter, the duodenum was immensely distended; so much so, that at first sight it appeared like the pyloric end of the stomach itself; and only by a more careful examination was the distinction between the stomach and intestine detected, by a ridge running around their place of junction.[1]

A child eighteen months old was admitted into the Hospital for Sick Children, under the care of Dr. West, apparently in much pain; constantly whining, restless, and throwing about her legs and arms. The mother had noticed that the child vomited frequently, rejecting everything she took; there was considerable constipation. The child died in a few days.

The stomach presented a constriction, beyond which was a pouch which looked at first like the stomach, but ended sharply at a spot where there was a fold of mucous membrane; beyond this followed intestine of ordinary character. A probe inserted into the bile-duct, from without, passed between the two surfaces of this septum, and appeared just below the stricture. The pouch was detected to be duodenum; and what appeared to be a fold of mucous membrane at the further end of the pouch, proved to be a septum stretched, with a slight obliquity, across the calibre of the bowel. The septum was perforated almost exactly in the middle, by a small hole nearly circular, and with a smooth edge. The valve possessed all the ordinary characters of intestinal mucous membrane.[1]

These strictures, so similar in position and in anatomical relations, were probably the result of an abundantly developed valve of the duodenum; that in the second case becoming more obstructive as the infant grew, on the principle that orifices in membrane or soft tissues, the result of diseased action, generally acquire a tendency to contract towards their centres.

Such cases are interesting, but are quite beyond the reach of treatment.

2. Obstructions, the result of foreign bodies lodged in the intestines, have already been considered in the essay on INJURIES OF THE ABDOMEN, VOL. I. p. 922 et seq.; we merely allude to them to complete the causes of obstruction in our table.

3. Twisting, "dislocation," or displacement of intestine, producing obstruction to the passage of its contents, is not a very common accident, but demands very careful examination when it occurs: for not only is its origin peculiar and its symptoms often obscure, but its treatment is a matter of very great consideration.

"Incarceration may be the consequence of a rotatory movement, and of this there are three varieties:—

a. A portion of intestine may have become twisted upon its own axis; and we then find that even semi-rotation causes such an approximation of its parietes that

[1] Pathological Trans., vol. xii., p. 101. From the plate which accompanies the description given by Dr. Wilks, it would appear that the contraction in all probability arose from a highly developed valve of the intestine; in the centre of this valve or stricture, may be seen a very small circular hole, apparently not larger than would admit a probe.

[2] Ibid., vol. xii., p. 121.

they touch, and close up the passage. This can probably only occur in the colon; and according to cases on record, only in the colon ascendens. Accumulation of gas, and unequal filling of different portions of the intestine, appear as far as we are able to judge from the few cases which have been noticed, to be the cause. Such an occurrence is scarcely conceivable in the small intestine, on account of the uniformity of its calibre, the absence of angular flexions, and its loose position, as every rotation of one portion upon its axis would be counterbalanced by the rotation of the next segment.

"*b.* The mesentery may be the axis, and the intestine will then be rolled up upon the former; *i. e.*, the entire mesentery, or a portion of it, is twisted into a cone; and in proportion to the number of its rotations, more or less of the intestine will be dragged after it. In this case we must take into consideration the traction and the pressure which the dependent mesenteric cone forms with the base whence its point rises. This variety can scarcely occur anywhere but in the small intestine and its mesentery.

"*c.* One portion of the intestine, either single or double—a coil—may afford the axis round which another portion with its mesentery is thrown, so as to be throughout in contact with the circumference of the axis, and thus to compress it like a ferule. This variety is evidently a higher degree of the first, in which a portion of the intestine is merely compressed from before backwards, and, as it were, flattened down. A coil of small intestine, the sigmoid flexure, or the cæcum, may form the axis.

"The last two varieties occur, like the first, chiefly at an advanced period of life. In early life, a predisposition to the affection may be caused by a congenital malformation of the mesentery, by large herniæ, or by small herniæ, when there is adhesion of the intestine."[1]

It is a matter of some importance to be reminded of, that the seat of *most* incarcerations *and of all twists*, will be found towards the posterior unyielding wall of the abdominal cavity; for it is only in that direction that pressure exerted on the intestine can effect its incarceration; the occurrence of a similar relation anteriorly is inconceivable, on account of the smoothness and yielding nature of the parts.

The symptoms of twisting of the intestine, especially of the sigmoid flexure (which is the most common variety), are very urgent from the first; great pain is suddenly experienced in a small circumscribed spot of the abdomen; obstinate constipation usually setting in from that date. If the sigmoid flexure is implicated, there soon follows very considerable distension of the abdomen, often distinctly observed to be chiefly confined to the left side. The distension of the abdomen is generally much greater when the large gut is affected, than when the twist implicates the small intestine. In the latter conditions, fluids may be injected into the rectum very readily, and may remain, or return tinged by fecal matter. In twists of the sigmoid flexure, we have injected fluids into this division of the bowel; if retained for a time, they do not return; the fluid has been thrown into the dilated sigmoid portion, and cannot again escape; vomiting is generally present, and often very copious and constant.

The following cases illustrate the history and pathological conditions of these accidents:—

A man, aged twenty-eight, having suffered for five days from irremediable constipation, died five hours after admission to the hospital-ship *Dreadnought*. The sigmoid flexure occupied nearly the entire portion of the front of the abdominal cavity, and was in a gangrenous state. The bowel was immensely distended; obliteration of the muscular bands, and rupture of the serous coat, having taken place. This portion of the gut had been originally highly developed, and had now become strangulated, from falling over on itself towards the right side, causing a twisting and strangulation. The patient had, on previous occasions, been subject to constipation.[1]

A man, aged sixty-five, was admitted into St. George's Hospital with a large circumscribed swelling, which occupied the greater part of the abdominal cavity, and apparently extended into the pelvis. Fluctuation could be distinguished over the whole of the tumor, the surface of which appeared smooth. No solid matter could be detected in any part of it. Percussion gave a clear sound in the upper part of the abdomen only, and there but to a small extent. *There was a tendency to diarrhœa.* A day or two after admission, peritonitis came on, with great pain in the abdomen and constant sickness. He died on the fifth day. The greater part of the peritoneal cavity was occupied by a large dark-colored tumor, which had displaced the various viscera, and encroached upon the chest. This mass was formed of the sigmoid flexure enormously distended. The dilated bowel was connected with the left iliac fossa by a pedicle formed by an exuberant meso-colon, which was twisted upon itself, and had thus occasioned partial obstruction of the gut; the communications respectively leading into the colon above, and the rectum below, being small and tortuous. The sigmoid cavity was

[1] Rokitansky, Pathological Anatomy, vol. ii., p. 52.

[1] Pathological Transactions, vol. i., p. 103.

distended with fluid feces, and contained one or two hard masses. The mucous membrane was of a dark livid color, but not ulcerated. Extensive evidences of peritonitis were present.

A man, aged fifty-five, was admitted into Charing Cross Hospital, nine days after almost complete obstruction of the bowels. A displacement of the bowel implicated the termination of the ileum, cæcum, and ascending colon. The latter was pressed upon and strangulated by the termination of the ileum and its stretched mesentery. Just at the part where the pressure was exerted, a gland in a calcareous state, as large and hard as a marble, lay immediately under the strangulated bowel, and had had considerable influence in exaggerating the obstruction, as every effort to force the contents of the gut onwards tended to carry the gland into the opening. Close above the constriction the internal coats were extensively ulcerated, and perforation was about to take place. In this case an attempt was made during life to relieve the obstruction by operation in the left loin, but without success, as the obstruction was above the opening made in the bowel.[1]

A boy was seized with a violent pain in the stomach, and with sickness. These symptoms continued, varying in intensity, with complete constipation. He died on the ninth day. The intestines were matted together. The duodenum, jejunum, and ileum were greatly distended; the lower part of the small intestine was highly inflamed, and two loops of it were quite black from congestion. The mesentery of these loops had been twisted on itself, and had caused strangulation of the gut attached; and while in this state, the folds had fallen on an intestinal diverticulum proceeding from the small gut to the linea alba, about one inch below the umbilicus, and thus gave rise to an additional amount of mechanical obstruction to the circulation and contents of the bowel.[2]

These cases are apt illustrations of the usual forms of "twist" of the bowel, such as occur, 1, in the sigmoid flexure; 2, about the cæcum; 3, of the small intestine. As a rule, such twists, when found in the small bowel, are usually nearer its lower than its upper extremity.

Rokitansky has very justly observed that the *predisposition* towards incarceration from twisting of the gut is dependent on a congenital, or acquired long, loose, flabby mesentery or mesocolon. But the mere existence of such a state, which allows very free movements of the bowel to take place, is hardly sufficient to account for sudden strangulation of the parts taking place. It appears to us that something is requisite to establish the twist; and that this something is to be found in an accumulation of feculent matter, invariably present wherever such twists occur. This accumulation of feces, fluid or solid, so loads and distends the bowel, that if accidentally it becomes shifted into a position unfavorable for the free passage of its contents, the intestine has no power to recover itself; nor has its peristaltic action any influence in altering its position, or that of the contained feces. The mischief once started continues to increase by continued inlets of feculent matter, without any corresponding outlet; for it will frequently be seen that though fluid feces from above can enter the sigmoid flexure when twisted, it rarely happens that much is able to escape into the rectum.

If, in the dead subject, the large intestine be distended artificially with water, and the mesentery of the sigmoid flexure be abundant, this portion of bowel is first seen to bulge forward, and then gradually to rise up towards the diaphragm. In this movement there is a slight tendency observed towards a folding of the intestine on its mesentery; this when the abdomen is open, and no restriction applied to the bowel. We have not, however, been able, by simply distending the sigmoid flexure, to produce actual twist; but perhaps our experiments are too restricted; and no doubt some other cause is wanting to induce it besides distension and free movement. Something, perhaps, depends on the motions of the body, more perhaps on the presence of the other viscera and abdominal wall during life. The following particulars of a case bear strongly on this portion of our subject.

A man, aged forty-five, was attacked on the 10th of November with diarrhœa. This ceased on the 12th. On the 13th he was occasionally sick, and complained of deep pain in the region of the bladder: and this pain became paroxysmal and severe until his death. Along the whole of the left side an unusually hard and broad ridge could be felt, extending from the region of the stomach to the bladder. Death took place on the 15th, almost suddenly.

The peritoneum contained a considerable quantity of bloody serum. In the epigastric region was seen the transverse colon, with the omentum stretched and adherent to the abdominal parietes, on the left of the umbilicus. The left side of the abdominal cavity was entirely occupied by the sigmoid flexure of the colon; it lay obliquely, and had forced the diaphragm high into the chest. The meso-colon, which was greatly thickened and elongated, had become twisted on itself, and the intestine with it. The gut was enormously distended by fluid feces, and was livid, from almost complete strangulation of its coats and vessels at the seat of twist. Mr. Gay, under whose care this case fell, found on examination that, in the state of tension, if the bowel was partly untwisted and then

[1] Pathological Transactions, vol. ii., p. 222.

[2] Ibid., vol. vii., p. 205.

relaxed, it sprang back forcibly to its acquired and altered position; but that this tendency became less as the bowel was gradually emptied of its contents, until it required little manipulation to restore the bowel to its natural position, and this without any marked disposition to again become twisted. He very justly remarks, *that usually the tightness of the twist is in proportion to the distension of the bowel.*[1] A tube passed up the rectum after death in this case was with some little trouble introduced into the sigmoid flexure, beyond the obstruction, and could empty the bowel. When this was effected, and the body rolled over on the side, the twisted bowel righted itself.

The facts just quoted point to this rule in treatment, that relief in twist of the sigmoid flexure is just possible without opening the abdomen, provided the long tube can be introduced into the distended gut, its contents drawn off, and the twist be reduced by the altered position of the bowel. But no operation for the ultimate relief of the patient will be successful, without the intestine be unloaded first, and the twist then reduced. It may be stated as an axiom in these cases, that once formed, the twist prevents the escape of the contents, and the contents of the twisted portion maintain the distortion; and to remedy the latter, the contents must be removed.

It will be observed that in one case already mentioned,[2] the serous covering of the intestine was found ruptured, after five days of constipation. This rupture had no doubt occurred previous to death. In an experiment made to distend the large intestine with water, the peritoneal coat in several places ruptured, before the muscular appeared inclined to give way under the pressure. This rupture of the peritoneum appears usually to commence over the transverse colon, and other portions are subsequently affected if the distension is continued.

This tendency of the peritoneum to rupture in sudden distension of the bowels, in cases of obstruction, points towards the importance of early interference, if any operation be considered beneficial. When peritonitis has set in, in consequence of rupture of the serous membrane, or any other cause, operative interference would probably be too late to hold out any prospect of success.

4. Obstruction of the intestines occurs from a portion of bowel being strangulated in a loop, or bound down by a cord of false membrane; or it may be constricted by a diverticulum, adherent by its apex to some opposed surface of the viscera; or by the Fallopian tube, attached by its fimbriated process to some point of peritoneum; or by a thickened and elongated piece of omentum fastened down at the ends by adhesions [or the appendix vermiformis may become attached, by an inflammatory process, to some of the surrounding viscera, forming a ring or arch, into which a loop of intestine may pass and eventually become strangulated; or the appendix may be spirally wound around the intestine in such a manner as to cause constriction of the tube]; or by other accidental circumstances. All these conditions favorable to the occurrence of internal strangulation, are entirely or partly the results of inflammation and effusion of lymph.

5. Peritoneal pouches, which have usually well-defined rings for their orifices, and the foramen of Winslow—but this rarely—have been the seat of obstruction and strangulation of the bowel.

The causes of obstruction mentioned in these latter instances are attended by symptoms entirely similar, and only require to be separated as regards their pathological conditions, but in treatment may be considered under one head. However, those obstructions which are due to the products of inflammatory action may occur at any time of life, but most frequently in the young, are very uncommon in old age, and are often found in children; whereas strangulation by a mesenteric pouch is usually observed in advanced life.

Females are rather more liable to internal strangulation than males; for the appendages of the generative organs offer additional points for adhesive inflammation, and, consequently, entail so much more danger. In most, if not in all, of the conditions now under consideration, the small intestine is usually alone implicated.

[According to the statistics of Leichtenstern, of sixty-six cases of diverticular strangulation, fifty-two were in males and fourteen in females. This writer also states that the accepted statement that strangulation by the vermiform appendix occurs much more frequently in women than in men, because the relatively frequent pelvic peritonitis of the former more often gives occasion for the formation of adhesions, is founded upon insufficient statistics. Admitting that pelvic peritonitis is more frequent in the female, it is overbalanced by the greater frequency of inflammation and of consequent adhesions of the appendix in the male. Thus of one hundred and six cases of inflammation of the vermiform appendix and typhlitis, eighty-nine were males and seventeen were females. Corresponding to this, of thirty-four cases of strangulation by the appendix, twenty-one were males and thirteen were females.]

[1] Pathological Transactions, vol. x., p. 153.

[2] See the first case on p. 601.

The history and pathology of internal strangulation caused by false membranes and adhesions producing loop, etc., are best illustrated by the following cases:—

A preparation in the museum of St. George's Hospital shows the formation of a short band of lymph, adherent by one extremity to the free surface of a portion of small intestine; from this the band is seen to pass over another portion of small intestine, and then is immediately attached by the other extremity to the mesentery supporting the latter piece of bowel. As the effused band of lymph contracted, it so pressed on the portion of intestine which was crossed by the band, that entire stoppage of the bowels was produced.

A young lady, aged nineteen, died after a few days' symptoms of strangulation and vomiting. The omentum was firmly adherent to the anterior abdominal wall. This was the result of old adhesions. The small intestines were greatly distended. At the lower part of the abdomen, on the right side, and dipping into the pelvis, a large portion of sphacelated intestine was seen. This was about five inches in length, and consisted of the ileum, which was constricted and strangulated by a ring formed by lymph which had been effused in some former attack of inflammation. The ring was so firm that it was obliged to be cut through to liberate the intestine. It was formed by the band of lymph being attached by one extremity to the inner surface of the caput coli and stretched across to the ileum, to which it adhered by the other.

A child four years of age died after five days' constipation and symptoms of internal strangulation. The cavity of the abdomen contained some serum deeply tinged with blood. At the lower part of the belly several convolutions of small intestine were highly congested and dark-colored; this to the extent of a foot in length; and one portion of it was almost black in color. This latter portion was found strangulated by a band of false membrane, which was attached by one extremity to the point of an appendix, by the other to the mesentery. The appendix was attached to the lower portion of the ileum, and was about an inch in length, and communicated with the bowel. The appendix and the band with its attachments, formed a complete ring about an inch in diameter.

A man, aged twenty, died after fourteen days' complete constipation. Near the termination of the ileum, a portion of it, nearly two feet long, much distended and much darker than the rest, was firmly constricted by a narrow band (not thicker than whipcord), which passed from the vermiform process to the ileum close to its mesenteric attachment.[1]

In a case in which a portion of small intestine was strangulated through a loop in the great omentum, perforation of the bowel had taken place, and had allowed the escape of feces.[2]

[1] Path. Soc. Trans., vol. ii., p. 62.
[2] Ibid., vol. i., p. 259.

A man, aged sixty-eight, was admitted into St. George's Hospital on March 7, 1861. He had been lifting some heavy iron about eight days previously, when he felt a sudden strain, and immediate severe pain in the loins and belly. He passed a restless night; the next morning there was slight action of the bowels. He complained of pain, chiefly in the belly, and dragging at the umbilicus; there was also constipation from the second day of pain. Four days after the attack he first vomited; but now everything taken was rejected. The skin was cold, and eye sunken; there was blueness of surface, and the pulse was small and weak; the tongue dry and brown; abdomen enormously distended and tympanitic. No stricture could be detected through the rectum. An enema-tube would not pass readily beyond a short distance. Mr. Johnson decided to open the descending colon, with a hope to relieve the distension; but the bowel, when cut down upon, was found collapsed. The question of making an exploratory opening in the abdomen from the front was considered, but decided against. The patient died on the eleventh day. The small intestine was very vascular. At the lower part of the ileum, close to the ileo-cæcal valve, a band crossed the small intestine, forming a ring around the gut and the commencement of its mesentery. The origin of the ring was observed to spring from the sigmoid flexure, which was drawn over to the right iliac region so as nearly to touch the cæcum. The tissue forming the ring was loaded with fat, closely resembling the structure of an epiploic appendix. The other appendices were very long and broad, and some were perforated at their base, and presented an incipient condition of such a ring as had embraced the intestine. There could be little doubt that this ring was either formed in an appendix, or was formed by the adhesion of two neighboring appendices. The gut, where it was bound down, was deeply marked by the stricture. From the stomach to the situation of the obstruction the bowel was greatly distended, but more particularly at the lower part, where for about a foot in length it was stretched so tight that it burst under a stream of water thrown in to wash it out; and was nearly black from congestion. The constricting band was not adherent to the intestine, and after removal from the body the gut could be easily moved backwards and forwards in the ring. The position of the obstruction was immediately over the right common iliac artery. The cæcum and upper part of the large intestine were of the natural size, and contained feces; the transverse and lower portion were empty and contracted.[1] The external wound was just below the left kidney.

Strangulation of bowel through the foramen of Winslow is most rare. We cannot point to any case within our own experience.

[1] Path. Soc. Trans., vol. xii., p. 111.

Obstruction caused by bowel becoming entangled or caught in a mesenteric or meso-colic pouch is not so unfrequent.

A specimen of meso-colic hernia, which had not been attended by strangulation of the bowel, was exhibited at the Pathological Society, by Dr. Peacock, in 1849; having been removed from the body of a man aged thirty. The left half of the transverse colon was deflected in a longitudinal direction, down the middle line, to the brim of the pelvis, and pushed forward by a large swelling, which projected on each side of the displaced colon. None of the small intestines were to be seen; but were found concealed in the swelling. This proved to be a large pouch formed by a fold of the meso-colon. It was opaque below, but the convolutions could be detected through it at the upper portion. The jejunum entered the pouch at the upper and posterior part, and the ileum passed out below and on the right side, about two inches above the termination of this portion of the intestine. There was no evidence of constriction of the bowel; nor did the displacement appear to have been productive of any inconvenience or disorder.

A second similar case was attended by strangulation of the intestine and death. A man, aged twenty-seven, was seized with pain in the abdomen, and vomiting. He vomited everything taken, and the pain in the stomach was most severe. He died about forty-one hours after the commencement of the attack. The descending colon was found lying on the left side of the cæcum, and the small intestines were contained in a large pouch formed in the left meso-colon, and situated on the left side of the corresponding large gut. The ileum passed out of the pouch about two inches above the cæcum, and at that point the bowel was contracted, thickened, and gangrenous.[1]

6. Invagination, or intussusception of the bowel, is often the result of irritation caused by worms; of tumors attached to the mucous membrane; and of other accidental causes, not always to be detected or explained.

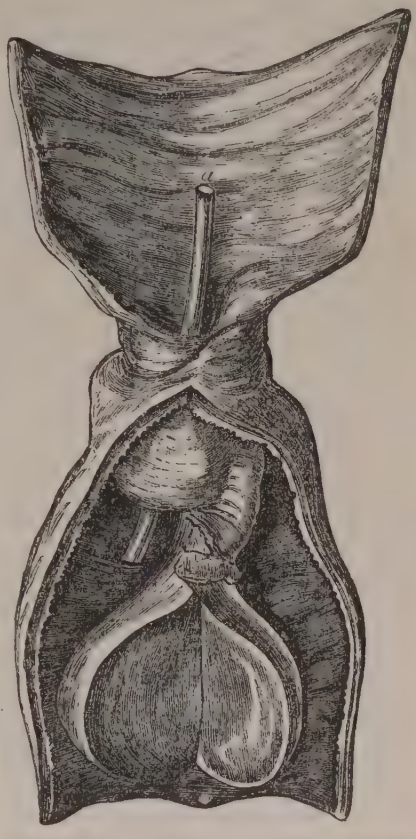
Invagination may frequently be observed in the post-mortem examinations of children ["invagination of the death struggle"]. It also often takes place in grown-up persons of all ages and of both sexes, and may occur in almost every portion of the intestinal canal.

Invagination may occur in one or in several parts of the bowel at the same time in the same individual; but we take it to be almost certain, that when obstruction occurs, it is the result of one extensively invaginated portion of gut; and that when in post-mortem examinations several intussusceptions are met with, they are but slight, and have not been productive of urgent symptoms during life.

[1] Path. Soc., vol. ii., p. 60.

In the Museum of St. George's Hospital is a preparation, which shows an intussusception caused by the presence of a tumor growing from the wall of the bowel and projecting into its cavity. A process of sloughing has nearly detached the prolapsed portion from the rest of the intestine, and so almost set free the tumor. The patient died of peritonitis.

Fig. 391.



Intussusception, caused by the traction of a fibrous tumor of the intestine.

Another preparation in the same Museum displays a portion of small intestine invaginated, apparently from the irritation set up by an ascaris lumbricoides, which may be seen coiled round the prolapsed portion. But many other parts of the bowel were also invaginated; and when the patient died, the state of the bowel was not suspected.

The anatomy of intussusception is interesting; we must devote a few words to its conditions.

The usual form of intussusception met with is an inversion of a portion of intestine into the tube of the gut immediately below. But the relative conditions of the upper and lower portions of the bowel may be reversed; the intestine below may

be projected into the intestine above, and this would still constitute an intussusception. This latter state must, however, be quite exceptional, even if it ever occur. The former is common and often fatal.

A perpendicular section through an invagination will display on each side, and lying parallel with each other, three layers of intestinal wall; a transverse section would show three rings of intestine, one within the other. In each section, whether perpendicular or transverse, the opposed surfaces of the intestine will correspond in character; peritoneum will touch peritoneum, and mucous membrane be in contact with a similar tissue. The outer surface of the external layer is of course peritoneum; the lining of the inner layer is of course mucous membrane; but between these there are two opposed surfaces of mucous membrane, and two likewise of peritoneum. Between the inner and middle layers, and in the space lined by peritoneum, will be a certain portion of mesentery or meso-colon dragged in by the inner layer of bowel as it becomes prolapsed. The limit of the invagination above is at the outer, or peritoneal surface of the bowel, and consists of an obtuse edge, formed by the folding in of the intestine at that point. The lower limit is inside the tube, and can only be observed when the gut is laid open. The portion of intestine which receives the invagination is a single layer; the invaginated portion, that which slips into the former, consists of two layers of bowel. A portion of mesentery will be found between these two layers, its size and shape varying with the length of the prolapsed intestine. The lowest extremity of this impacted mesentery is almost drawn to a point, and is near the extreme lower part of the prolapse. The mesentery is thicker and broader where it enters the fold between the two layers of intestine, so that it becomes somewhat triangular in shape as it lies between the two layers of intestine already alluded to. As the mesentery is attached to one margin of the bowel, the bowel in prolapsing is somewhat retarded by the mechanical action of the former; for the mesentery, being always in a state of tension, drags upon one side of the prolapsed bowel; it will therefore be found, especially in an extensive prolapse, that the prolapsed end of the gut, its inner extremity, is turned in the direction of the attached mesentery; from which circumstance the piece of bowel presenting the prolapse will be found slightly curved to one side, and thus the whole mass assumes a crescentic figure.

Rokitansky, in referring to this condition, makes the following important remarks. "First, that the invaginated portion does not lie parallel with its sheath, but always offers a greater curvature than the latter, the inverted tube being compressed on its concavity into tense tranverse folds. Secondly, that the orifice of the invaginated portion of bowel does not lie in the axis, or in the centre of the sheath, but towards the side; and that, following the traction exerted upon it by the mesenteric fold that belongs to the inverted intestine, it is directed towards the mesenteric wall of the sheath; that the opening is not circular, but represents a fissure. This affords a diagnostic sign for the examination of intussusceptions of the rectum, which are within the reach of manual exploration."[1]

Invagination may go on to involve a large portion of the small, and the greater portion of the large intestine. When an intussusception increases in size, the *involution* is that of the bowel below the commencement of invagination; if this commences at the lower part of the ileum, more of the upper ileum does not disappear, but the prolapse grows in length at the expense of the inferior portion of the intestine, cæcum, ascending colon, etc.; each of which in turn would become folded in, as the prolapse increased.

We do not attempt to explain the causes of intussusception. In all probability, an empty state of intestine, and some irritating cause under such conditions, are essential to its production.

["The mode of origin of intestinal invagination has been explained as due to the forcing of a portion of intestine possessing normal or increased peristaltic action into a portion lying below it, and paralyzed by violent diarrhœa, ingesta, traumatism, or partial peritonitis. Another early theory of the for mation of intestinal invagination was that it was due to the tetanic contraction of the circular muscular fibres of a short portion of the intestine, in consequence of which the latter is forced by the peristaltic action of the portion lying above it into that which lies below, and is then firmly grasped. Presented in this way, the theory is scarcely correct; but, as the following will show, there is a certain foundation for it.

"The fact thati nvagination occurs so much the more frequently in the region of the cæcum and in the lowest portion of the ileum immediately above the ileo-cæcal valve, has always invited attempts at explanation. Special importance has been attached to the greater breadth of the cæcum and colon into which the smaller ileum could easily enter; also to the more fixed position of the colon, which forms the sheath, as compared with the greater mobility of the penetrating ileum rendered possible by its mesentery. The greater sluggishness, too, of the former has been invoked, and the more vigorous peristaltic action of the latter.

[1] Path. Anat., vol. ii., p. 55.

"The importance of these factors is certainly not to be underestimated, but the principal cause is to be found elsewhere. If we consider that the ileo-cæcal opening is distinguished by a sphincter, the contraction of which can increase to powerful tenesmus, we recognize that there is a complete analogy between the conditions of invagination in the region of the cæcum and the different kinds of prolapse of the rectum, which, like ileo-cæcal invaginations, is found most frequently in early childhood. Just as anal tenesmus, excited by any cause whatever (rectal blennorrhœa, profuse diarrhœa), usually excites and accompanies prolapse of the rectum, so is ileo-cæcal tenesmus, excited by catarrh or abnormal irritability of the terminal portion of the ileum, of great importance in the production of many ileo-cæcal and ileo-colic invaginations. In many cases in which we see invaginations in the region of the cæcum follow prolonged diarrhœa or colic, the taking of unsuitable food, or, especially in early infancy, the withdrawal of the mother's milk and the substitution of improper food, cæcal tenesmus plays an important part. If the cæcum and the colon are rendered easily movable by their mesentery—as is regularly the case during early life—the repeated and more forcible peristaltic pressure towards the persistently contracted ileo-cæcal sphincter causes ileo-cæcal invagination. If the cæcum is firmly fastened down, so that it cannot be turned in and invaginated into the colon, prolapse of the ileum into the colon takes place, with formation of an ileo-cæcal invagination, just as prolapse of the rectum may follow violent anal tenesmus. If neither of these happens, invagination of the lowest part of the ileum may occur, as is also the case in the rectum when it becomes invaginated in itself above an obstinately contracted (tenesmus) sphincter, and is finally prolapsed (prolapse of the rectal wall with invagination).

"If ileo-cæcal invaginations are very common in children, and ileum invaginations, on the contrary, very rare, the reason lies in the greater mobility of the cæcum and ascending colon allowed by their mesentery, and the consequent removal of an obstacle to invagination. In adults this obstacle is removed, and we find ileum invaginations as frequent as ileo-cæcal. Probably a not uncommon abnormal mobility of the cæcum and ascending colon is an element in the production of the latter in adults also.

"An important part in the etiology of invaginations is taken by neoplasms of the intestinal canal, especially such as have a pedunculated attachment to the mucous membrane, and project in the form of a polypus into the lumen of the canal. The records are full of cases of invagination due to polypi. Since the polypus is grasped by the peristaltic action and forced towards the anum like the rest of the contents, it draws the intestine from which it springs as an intussusception behind it.

"On the other hand, it is exceedingly uncommon for circular stenosis of the canal to cause invagination, for the reason that the introduction of the voluminous intestine above the stenosis, preceded by the stenosed part, into the usually contracted portion lying below it, meets with mechanical obstacles. Where these do not exist, as in stenosis of the ileo-cæcal opening, we find that intussusception is not uncommon.

"Among the incidental, and in part also indirect, causes, a well-ascertained part, according to the most trustworthy observations, is played by improper ingesta, traumatism of the abdomen, violent jarring of the body, prolonged diarrhœa, colics, and constipation. The mode of action of these causes can be easily made out by the aid of the foregoing.

"In earlier times, when intestinal worms were supposed to be the cause of many diseases and morbid symptoms, they were often held responsible for invagination of the intestine also. There is no support for such an opinion. Sometimes the ascarides, as Ruysch described and De Haën pictured it, wind themselves about the intussusception—an entirely unimportant incident which can have no connection with the etiology, for the reason that an intussusception must be present before the ascarides can wind themselves about it."[1]]

If invagination increases beyond a slight extent, a change will soon occur in the condition of the implicated piece of bowel; which, we may predict, places it beyond hope of reduction, accidental or applied. From the pressure exerted on it and its mesentery, congestion, followed by inflammation, soon commences. The result of this condition is a more than natural secretion from the mucous surface, and often a bloody discharge mixed with mucus. This is a symptom of some importance in the diagnosis of intussusception. The whole mass then becomes thickened, and peritonitis usually commences about the upper part of the invagination, and extends more or less over the general surface. This onset of peritonitis is usually sufficient to ensure adhesion of the opposed surfaces of the peritoneum, at the entrance or upper ring of the sheath. At this line there will also be a certain amount of strangulation exerted upon the portion within the ring. This is the first step in the effort made by nature to remedy the evil, now rendered irreducible, in order that presently the prolapsed portion may be cast off by sloughing; and that the escape of the contents of the bowel may be provided against, by the union of the upper and lower portions of the otherwise severed intestine.

Peritonitis of a severe character usually occurs when a large portion of intestine is involved, and soon carries off the patient; but should he survive this attack,

[1 Leichtenstern, Constrictions, etc., of the Intestines.—Ziemssen's Cyclopædia of Medicine, Am. ed., vol. vii., p. 616 et seq.]

he may yet recover. The involved portion may slough, and be passed by stool, and the patient rise from his bed convalescent in a few weeks.

The further history and treatment of intussusception is best illustrated by the following cases.

A boy, nearly five years of age, complained of soreness about the anus, the result of ascarides. The next day he was seized with sudden pain in the lower part of the abdomen, and strained several times at stool, but passed nothing. He soon afterwards vomited. He continued to go to stool every half-hour. In the afternoon he experienced constant desire to go to stool, and passed a clot of blood. On some of these occasions he passed dark-colored blood and slimy matter. There was great restlessness, and thirst. The abdomen was more swollen above than below the umbilicus. There was much tenderness over it on pressure. The symptoms continued unrelieved, and death took place on the fifth day. A considerable intussusception had occurred of the ileum through the ileo-cæcal valve; the appendix was also carried in. About 3½ inches of bowel protruded into the cæcum. The involved part was of a deep red color. It was so firmly grasped by the ileo-cæcal valve, that the effort to reduce it appeared likely to tear the bowel.[1]

A child, six months old, died after sixty hours of suffering from vomiting and discharge of bloody mucus from the rectum. The whole of the colon, ascending, transverse, and descending, had passed into the sigmoid flexure. The mucous membrane of the prolapse was purple from strangulation.[2]

The two foregoing cases mark the prominent symptoms of acute invagination of intestine; sudden pain; constant and urgent desire to stool, with little fecal matter passed, but blood in clots or bloody mucus escaping in small quantities; more or less vomiting; great distress, both general and local; and death following in a few days. But death may be somewhat sudden.

A sailor, during a railway journey, was observed to place himself on the floor of the carriage, but had no attention paid him by his fellow-passengers. At the journey's end he was found dead. The abdomen presented marks of severe peritonitis. A fold of intestine near the termination of the ileum, six inches in length, was intussuscepted and gangrenous. Probably in this instance the mischief was of some few days' duration.[3]

In other instances the symptoms appear to extend over a much longer period, and ultimately prove fatal; or if the strangulated bowel slough off, may terminate favorably.

A man, aged twenty-five, suffered from attacks of colicky pain in the abdomen, and gradually lost flesh. One day he became suddenly worse, and on the following day died; nearly four months from the supposed date of the commencement of his attack. About six inches of ileum, cæcum, and the first part of the ascending colon, had passed into the large bowel beyond. There was no appearance of gangrene in any part. The colon contained much mucus and coagulated blood. The mucous membrane was turgid and purple. The involved layers of the intestine were firmly adherent to each other by dense bands of false membrane.[1]

Recovery after the passage of the strangulated portion of the bowel through the rectum is the only fortunate result that we can anticipate in a case of chronic intussusception, and fortunately is a result which occasionally takes place; nor does the loss of the bowel appear to be attended by any subsequent evil consequences, *i. e.*, contraction or stricture of the gut, so far as we have been able to investigate the subject.

A boy, aged five, was taken ill four months previously to the time at which a mass of bowel was passed. At first he suffered from simple fever, but afterwards experienced much distress. He complained chiefly of pain in the region of the bladder; but there was no tenderness. The urine was sometimes retained for a long time. The bowels were very much confined, sometimes for fifty hours. There was occasional vomiting. He was never known to pass blood. *Eight inches of the ileum, the cæcum with its appendix*, and about four inches of the colon, were passed by stool. The tissues were almost black, and offensive. Diarrhœa preceded the discharge of the separated bowel. At the end of six weeks from this event the little patient seemed quite well, and the bowels acted regularly.

This case occurred in 1847, under the care of Mr. Hesilridge Buckby, of Sutton-on-Trent. In September, 1863, he kindly wrote to the author to the following effect: "I have much pleasure in informing you my little patient has continued *in perfect health* ever since his restoration. I saw him the other day."

V. T., aged eighteen, was seized with severe paroxysmal pain in the abdomen. This continued and increased without relief; and was followed by stercoraceous vomiting. Symptoms of general peritonitis came on, without any relief from the bowels. The more urgent symptoms were relieved under the use of calomel and opium; but no evacuation was obtained. On the tenth and following day enemata were returned without any fecal tinge. On the twelfth day some feculent matter was brought away: and more feces

[1] Path. Trans., vol. ii., p. 55.
[2] Ibid., vol. ii., p. 56.
[3] Ibid., vol. i.. p. 77.

[1] Path. Trans., vol. vii., p. 193.

passed after a dose of castor-oil. On the nineteenth day he had three motions. The last consisted of bright florid blood, mingled with many portions of the small intestine. The two previous motions were said to have been of precisely the same character, and to have contained many "skins." At the expiration of six weeks the patient returned to his usual occupation.[1]

Peritonitis may be the result of perforation of the bowel during the separation of the sloughing prolapse; in which case death is generally rapid, and attended by acute pain and much suffering.

The average number of deaths from intussusception, taking all ages, must be very small. In five years there were admitted into the Hospital for Sick Children, in-patients 1,920, out-patients 46,298—total, 48,218. Only one death from invagination of the intestine occurred among this number of patients.

It will appear that, although invagination has been classed with the causes of acute strangulation, many cases occur in which these symptoms are not very acute, and last some time, or even terminate in recovery, though at a sacrifice of a portion of the bowel.

Invagination may be suspected when there are present acute pain, sudden in its attack, and confined in extent; constant and urgent desire to stool, without any relief, with the passage of blood and mucus, and sometimes a swelling, sausage-like in shape, may be felt, in the ileo-cæcal region; with constipation and vomiting; but all evidence of swelling is frequently wanting. No age is exempt from invagination; but children are most liable to its occurrence. The pain in such instances is often intermittent: when present, the child doubles itself forwards, and often rests its head on the bed, kneeling.

The treatment should chiefly consist of opiates; with the addition of calomel when peritonitis sets in, and leeches to the part in pain. The proposal to open the abdomen should not be entertained. The cases recorded will justify this opinion. And if general measures give no relief, we have only the one hope left, that the involuted portion may be thrown off by slough, and thus the obstruction be removed.

Distension of the lower bowel with fluid or air has been recommended, and even stated to have been successfully applied in cases of urgency; but however promising this kind of treatment may appear, it must be recollected that, even when the abdomen has been opened, it has been difficult, and in some cases impossible, to reduce the involution without tearing the bowel. A case is, however, recorded by Dr. Baldwin, of Jacksonville, Florida, of recovery in supposed invagination, treated by injecting a very large quantity of fluid into the rectum.[1]

We have now to consider the more chronic conditions productive of obstruction.

1. Habitual constipation may become accidentally prolonged to such an extent as to cause anxiety; or the accumulation of fecal matter may be mistaken for a tumor, so circumscribed occasionally is the collection in the large intestine. The time which may elapse while the bowels are entirely closed, and the amount of feces which may be collected therein, would surpass belief, were it not that the experience of those now living can confirm the statements made by writers on this subject.

A lad, aged seven, on recovering from an attack of fever, was affected with great torpor of the bowels. This gradually increased to such an extent, that in two years treatment failed to have any effect. When admitted into the Free Hospital, under the care of Mr. Gay, *nothing whatever had passed from the bowels for three months.* The health had not suffered; the appetite was good. The body was greatly enlarged, and was forty-nine inches in girth; and there was inconvenience to respiration. There was considerable prominence on the left side, as if the colon and sigmoid flexure were chiefly loaded.

A speculum was passed into the rectum, and after dilating it, an enema tube was passed high up. The contents of the bowel were washed out by a stream of warm water kept constantly playing upon them, for half an hour at a time. A large quantity of hard black feces, like cinders, was brought away. These measures repeated several times reduced the girth of the abdomen to twenty-six inches.[2]

The surgeon is usually consulted at the latter period of obstinate constipation, which has at last arrived at complete obstruction of the intestine; and as all power of propulsion is then lost, the contents have to be removed mechanically. This can only be done by the aid of repeated warm-water enemata; or by means of some kind of scoop or short lever, with which the lowest masses of hardened feces should be carefully dislodged.

Purgatives in such cases are not of much use, until the load is somewhat reduced in the lower bowel.

The following very instructive case is mentioned, in a letter to Dr. Burne, by the late Dr. R. Williams, Physician to St. Thomas's

[1] Path. Trans., vol. vii., p. 199.

[1] American Journal of Medical Sciences, Oct. 1852, p. 568.

[2] Path. Trans., vol. v., p. 174.

Hospital. A lady, aged thirty-five, was attacked with severe gastrodynia, and most obstinate constipation. Paroxysms of the pain recurred at short intervals, gradually became more frequent, and at length quotidian. Each meal was followed by pain so severe and continued, that she limited herself to dry biscuit and brandy-and-water; and this was commonly rejected. Nothing gave relief but opium, of which, for months, she took not less than sixty grains daily. Her bowels, independent of the astringent effects of opium, were always greatly constipated; and no quantity of salts, oil, or senna in the least moved them; elaterium, croton-oil, or other powerful purgatives, immediately inverted the action of the stomach, and were rejected. Calomel was the only medicine which would act upon the bowels, and this not until her mouth was affected.

From this cause she frequently had no evacuation for *six weeks* together; and in one year, when much weakened by repeated salivation, so that it was necessary to defer the administration of the calomel as long as possible, she had only one evacuation every *three months, or four in the year.*

At the times her bowels acted she suffered immensely, her pains being more severe, if possible, than those of labor. The fecal matter when passed was enormous in quantity, healthy in color, and was formed into large round lumps or scybala, each certainly not less than a large fœtal head, and so numerous as often to fill a common-sized pail.[1]

We may, perhaps, have travelled somewhat from the path of our especial calling, in introducing the latter cases, illustrative of chronic obstruction of the intestine. But the accumulation of large quantities of feces is often productive of a strange and anomalous train of symptoms; often such as indicate structural obstructions; or simulate morbid growths in the abdominal cavity. Experience, discrimination, and careful examination are often requisite to insure a correct diagnosis as to the true nature of these collections: and without extreme caution, the surgeon may be baffled in his attempts to unravel the conditions attendant on a loaded intestine, accompanied by obstinate constipation. With a gut greatly distended by fecal matter, and with the symptoms of organic obstruction, it will frequently happen that the bowels act freely, and yet without relief, or any reduction of the size of the abdomen. It is but the overshot of the sluice; the head-stream is dammed up; the canal is loaded to overflowing.

2. Obstruction, the result of injury, we need but allude to here. The conditions and treatment have been already described; see Vol. I., p. 886.

3. Constipation, occasionally amounting to obstruction of many days' standing, or even of a fatal character, is apt to occur in cases of peritonitis, attendant on tubercular deposit in the subserous cellular tissue, or the result of other causes; a condition often accompanied by ulceration of adjacent and adherent surfaces of the intestine.[1] A direct communication thus takes place between two or more opposed surfaces of bowel: often an abscess is found within the abdomen, communicating through ulcerated openings with several portions of the intestinal canal; there is great irritability of the stomach, and often rejection of all food; an unyielding abdominal wall, and an irregularity of its surface; general but not exquisite tenderness; and constipation of, perhaps, some days' standing. Such symptoms might, at first sight, convey the idea that obstruction was due to some of the causes previously enumerated. But in such cases as we have now under consideration, there are usually general indications of tuberculous cachexia long before symptoms of obstruction set in. The condition of the bowels is, however, as a rule, extremely uncertain in these cases: occasionally confined, but more frequently purged. With adhesion of peritoneal surfaces, and ulceration through the coats of the intestines, obstruction is rare; and is rather the exception, unless the calibre of the bowel is contracted by the pressure of abscess, or diminished by false membrane, or other media, stretched across the tube. Looseness of bowels is the usual condition in the cases just considered.

4. Stricture of the intestine is the most common cause of obstruction.

Strictures of the intestine occur under various conditions, independent of cancerous deposit in the walls of the gut. The chief causes of simple stricture are due to the action of caustic substances; to the presence of foreign bodies, causing ulceration and contraction; to tuberculous ulceration; to ulceration of the mucous membrane without any known cause; to the thickening attendant on old reducible hernia; and to an inflammatory action taking place in the walls of a portion of the intestine, terminating in the effusion of fibrin, and subsequent contraction of the canal.

Stricture, the result of disease of the upper portion of the small intestine, is rare. We believe, when met with, it usually follows cicatrization and contraction after ulcer, the direct effect of some escharotic accidentally or intentionally swallowed; or of some other form of ulcer which, in healing, has contracted the diameter of the gut.

[1] Burne, On Habitual Constipation, p. 28.

[1] An interesting case is recorded by Dr. Bristowe, Path. Trans., vol. viii., p. 200.

Stricture of the duodenum is uncommon. We have met with a few instances of it. In the Museum of the College of Surgeons is a specimen of a stricture of the duodenum; the stricture is half an inch in length. It appears simple in its character, but has no history attached to it.[1]

The following case well illustrates the effects of an escharotic substance introduced into the stomach. A woman, aged forty, accidentally swallowed about half a wine-glassful of "Burnett's solution" (chloride of zinc), and was immediately seized with violent pain and vomiting; but under treatment recovered from the immediate effects of the poison. A month afterwards, pain and vomiting returned; and in about two months after she was admitted into St. Mary's Hospital, under the care of Dr. Markham. All food taken was rejected; and she died about four weeks after her admission, and some three months after taking the fluid. In the pyloric portion of the stomach, about an inch and a half above the valve, the stomach was so contracted as only to permit the passage of a small bougie. The constriction was clearly the result of a cicatrix.[2]

A young lady had accidentally some "Burnett's fluid" given her instead of a dose of medicine. Acute pain and vomiting were the immediate result, and for many months life was despaired of; by degrees the stomach became more tolerant of food, and was able to retain small quantities of fluid nourishment, taken at frequent intervals. It is now some five years since the accident; but still the greatest care is requisite on the part of the patient as regards her diet. It can only be taken in a fluid form, in small quantities; and is generally required at intervals of four hours. Solid meat, or indiscretion in quantity of food, at once produces vomiting, and the contents are rejected. The health is in every other respect good. No doubt some contraction has taken place from ulceration, caused by the caustic applied to the pyloric extremity of the stomach or to the duodenum.

Stricture following other forms of ulceration is occasionally met with. A specimen of stricture of the ileum after ulceration is recorded by Dr. Bristowe. The ileum and lower part of the jejunum presented numerous ulcers, mostly cicatrizing. At the commencement of the ileum a cicatrix had formed, and reduced the calibre of the intestine to such a degree that the point of the little finger could barely be inserted. Below, the bowel was contracted; above, it was considerably dilated. One slough, opening through the intestine, allowed the escape of feculent matter into the peritoneal cavity. The intestinal wall at the strictured part was an inch thick. Throughout the large intestine were numerous cicatrizing ulcers. The history of the patient did not throw any light on the case. For some years she had been liable to sudden attacks of pain and constipation.[1]

A man, aged fifty-four, had been poorly for twelve months. At the commencement of that period he had suffered from an attack of fever, since which he complained of pinching pain in the bowels; the abdomen became swollen; and he lost flesh. He could take very little food; was constantly sick, but the bowels acted once or twice daily. A constriction of the ileum was found at the junction of the upper with the middle third, dependent on great thickening of the walls of the bowel. The stricture was an inch long, and barely admitted the tip of the finger. Immediately above this, the bowel formed a pouch, the parietes of which were thinned almost to perforation. In this pouch were found thirty-three plum-stones, and sixteen cherry-stones, all perfectly black; and half a dozen recently-swallowed orange-pips. There was an oblique inguinal hernial sac, into which it was evident, from the position of the parts, that the strictured portion of the intestine had been in the habit of passing.[2]

[A case is reported by Dr. H. Lenox Hodge,[3] in which the constriction of the intestine was due to a great accumulation of fat around the descending colon.

"A mulatto, 58 years of age. Her general health had been good, although she was exceedingly fat. About three weeks before her death she had fallen heavily from a chair, striking her abdomen. During the last two weeks she had obstinate constipation and bilious and stercoraceous vomiting. The abdomen was tympanitic, but greatly distended. Injections given with Davidson's syringe came away quickly, and even when given in large quantities returned perfectly clear, without being discolored with feces. A large tube could be passed high up the rectum, and when the injection was thrown up this tube it brought away small quantities of fecal matter, and the fluid came away discolored. *Post-mortem:* abdominal wall very thick and fat; omentum exceedingly thick, being loaded with fat. There was extensive peritonitis over the region of the small and large intestines. There were bands of lymph binding together the folds of the small intestine. The most severe inflammation was at the beginning of the jejunum. The coats of the intestine were there of a chocolate color. The ascending and transverse colon were smaller than usual, but presented the normal sacculated appearance. Their epiploic appendages were, however, enormous. The descending colon was apparently buried in the fat of the epiploic appendages. It could not be distinguished except by section. A section was made just above the sigmoid flexure; the coats were found very thin, and the calibre of the tube was so small as scarcely to admit the

[1] Series xxiii., No. 1176.
[2] Path. Trans., vol. x., p. 164.

[1] Path. Trans., vol. iv., p. 153
[2] Ibid., vol. x., p. 154.
[3] Trans. of the Phila. Path. Soc., vol. vii., p. 19.

forefinger. Below this point the intestine was empty; above it, a hard mass of feces, about the size of a walnut, filled the colon, and could only be pressed out by force. The muscular power of the intestine could not have moved this mass any further in the narrow canal. The injections had washed out the bowel below, but had failed to make any impression on this mass. The rectum was also small, but everywhere could receive the forefinger."]

These cases are interesting when we consider the causes of the strictures described. In the third, though there was extensive ulceration of the bowel above and below the strictures, the symptoms, and the nature of the latter, incline us to believe that contraction of the bowel from cicatrix was the primary disease. In the fourth case it is most probable that inflammation, produced by the bowel frequently slipping into the old hernial sac, was the original cause of the stricture, quite independent of the attack of fever, or of any ulceration of bowel following that attack.

In allusion to this consideration, viz., whether the ulcerations of intestine in fever are subject to contraction, and are thus productive of stricture, Rokitansky observes that the cicatrices "have occasionally been observed thirty years after the fever had occurred;" and he adds, "it is singular and characteristic of this ulcer and its cicatrix, that they never in any way give rise to a diminution of the calibre of the intestine."[1]

Of the healing of ulceration, the result of tubercular infiltration, he further observes: "In consequence of the contraction of the ulcer, a cicatrix forms on the surface of the intestine, which presents a more or less elevated ridge on the internal surface of the intestine. If the ulcer was of considerable size, or if it encircled the entire intestine, a callous annular ridge remains, which diminishes the calibre of the intestine, and when viewed from without occasionally gives rise to an appearance of invagination. Thus the healing of a tubercular intestinal ulcer is always accompanied by a diminution of the intestinal calibre."[2]

So, also, in the ulceration of the bowel under attacks of dysentery, he observes: "In cases of extensive destruction of substance, the approach of the edges is rendered impossible; the deeper layers of the tissue, which takes the place of the mucous membrane, are frequently condensed into fibrous bands, which form corded projections into the intestinal cavity, interlace with one another, and not unfrequently encroach upon the calibre of the intestine, in the shape of valvular or annular folds, thus giving rise to a stricture in the colon of a very peculiar form. This mode of regeneration is more remarkable, as it closely resembles that following the destruction of the œsophageal mucous membrane by mineral acids."[1]

A case of stricture of the sigmoid flexure, near its junction with the rectum, is reported by Dr. Peacock.[2] The contraction was apparently due to the cicatrix of an old ulcer. There was much thickening, puckering, and induration of the internal tunics. There was no appearance of any cancerous deposit. Immediately above the stricture the cavity of the intestine was very large, and an ulcerated aperture of sufficient size to admit the passage of the thumb, existed on the anterior and inner side; a portion of fecal matter had escaped into the cavity of the pelvis.

5. Obstruction may also be the result of stricture, dependent on cancerous deposit in or about the walls of the intestine. Less frequently, it is occasioned by tumors or cysts pressing on the bowel: such as fibrous tumors of the uterus; ovarian cysts; hydatid growths, or other masses, which originate in, and encroach upon, the abdominal cavity. The ultimate effects of most of these causes of obstruction are equally fatal. Their treatment must of course vary according to their conditions; but life may be prolonged many months under proper care and judicious management. Cancerous affections of the intestine usually run the most rapid course; but even in these cases life is occasionally prolonged much beyond the period which may at first be anticipated.

Cancer of the intestine occurs most frequently in the large bowel. When the small intestine is affected, usually the disease has attacked it secondarily, having originated in some contiguous viscus. The nature of the deposit varies much in different cases: true scirrhus, medullary deposit, or villous growth, will each be met with; but the latter less frequently than the former, and true scirrhus less often than the medullary form of cancer; but, as Rokitansky justly observes, they "may be combined with one another, from their first origin, or consecutively."

"The colon," he continues, "is almost exclusively the seat of cancerous degeneration; but there is a gradation in the proclivity of its different sections to the affection. The rectum is most frequently attacked; in second order, the sigmoid flexure; and the remaining portion of the colon but rarely. . . . Carcinoma oc-

[1] Path. Anat., vol. ii., p. 73.
[2] Ibid., vol. ii., p. 96.

[1] Path. Anat., vol. ii., p. 87.
[2] Path. Trans., vol. xiii., p. 97.

curs as a primary affection of the intestine in three forms. First, in the mucous membrane, as carcinomatous infiltration of the erectile tissue, into which the former has been previously converted—fungus; secondly, more frequently in the submucous cellular tissue, as round nodulated accumulations; thirdly, most commonly as an annular deposit of the cancerous tissue in the submucous cellular layer."[1] And he adds, that "cancerous stricture of the intestine is the most common variety of stricture that results from alterations in the intestinal coats, and at the same time the one that advances to the highest degree."

The following case illustrates the history of such a stricture:—

A man, aged fifty-eight, was admitted, under the care of Mr. Birkett, into Guy's Hospital, with constipation, which had existed for a week. Twelve months previously the patient had been attacked with diarrhœa, sickness, and great pain over the whole of the abdomen. The diarrhœa ceased, but the attacks of sickness and pain recurred at intervals. He lost flesh. The bowels were sometimes costive, at others relaxed. He became gradually worse in every respect, and then sought admission into the hospital. At this time he had constant nausea; frequent vomiting every two or three hours, and always after taking food. The abdomen was tense, but not tympanitic. There was a swelling in the right inguinal canal, but no hernia could be detected. Two days after his admission, as the symptoms were not relieved, Mr. Birkett cut down upon the old hernial sac; but no intestine was found in it. The symptoms became gradually more distressing, and the patient died about four days after admission. The right flexure of the colon was constricted, as if a string had been tied round it. "Within this constricted part, a growth was seen attached to the anterior wall of the bowel; and was of the nature described by Rokitansky as 'villous cancer.'"[2]

Malignant, or cancerous deposit, productive of stricture of the intestine, though usually found to affect persons past the meridian of life, may occasionally be met with in youth.

A boy, aged fifteen, was the subject of a stricture of the rectum from three to four inches from the orifice of the bowel. The stricture was very tight, and accompanied by ulceration of the mucous membrane. The stricture was caused by the deposit of medullary cancer external to the muscular fibres of the gut. The patient died of acute peritonitis.[3]

[1] Path. Anat., vol. ii., p. 97.

[2] Path. Trans., vol. iv., p. 154. The preparation is illustrated by an excellent engraving in the Transactions.

[3] Ibid., vol i., p. 67.

Advanced age generally appropriates to itself those forms of intestinal obstructions which take their origin in cancerous deposits. From the pylorus to the ileo-cæcal valve, from the cæcum to the rectum, there is no portion invulnerable to their attacks. Occasionally they are found to affect the duodenum; somewhat oftener the jejunum and ileum; most commonly the lower portions of the large intestine. If medullary stricture be found in youth, the rectum is almost invariably the seat of the mischief.

The pressure of a fibrous tumor has been known to produce obstruction. An ovarian cyst may occasion stoppage of the bowels.

A woman was admitted into the Middlesex Hospital, under the care of Mr. Moore, suffering from constipation, and at the same time was the subject of a large ovarian cyst. The constipation did not yield to treatment until the fluid of the cyst was withdrawn, when entire relief was afforded to the symptoms of obstruction.

Spasmodic strictures, as they are termed, appear to depend on disordered or costive bowels; and need no comment from us.

Before entering upon the consideration of the treatment of obstructions of the intestines, it appears desirable, 1st, to attempt some kind of estimate of the periods of life at which different kinds of obstruction may occur; 2d, to review generally the respective symptoms dependent on those various organic or accidental conditions; and 3dly, to determine under what circumstances, and with what hopes, operative interference may be adopted.

As regards our first proposition, we have arrived at the following, rather general, conclusions: that obstructions occur in the following order of frequency, from the various causes mentioned, in youth, middle age, and old age: viz., in youth, from internal strangulation by bands of lymph, omentum, or adherent diverticula; from adhesions of various coils of bowel to each other; from intussusception; from foreign bodies taken by the mouth; from cancer, rarely, and hitherto found in the rectum only:—in middle life, from twists of large or small intestine; from gall-stones, intestinal concretions, and foreign bodies; from intussusception; from simple stricture; from mesenteric hernia; from internal strangulation by bands, etc.; from peritonitis, often resulting in abscess; and from simple constipation; from cancer:—in advanced life, from cancer; from thickened intestine, the result of old reducible hernia; from intussusception; from simple stricture; and lastly, from internal strangulation.

The following table indicates the rela-

tive frequency of different causes of obstruction irrespective of age. The results are taken from Mr. Hinton's valuable communication on intestinal obstructions.[1]

In 135 cases, the following were the causes of obstruction, in the order of their frequency :—

Diseased uterus		1
Stricture of ileum		1
Cancer of small intestine		2
Internal hernia :		
Inguinal, high up	1	
Diaphragmatic	2	
Meso-colic	2	8
Obturator	3	
Fecal accumulations		3
Twist of sigmoid flexure		4
Concretions, calculi, foreign bodies		7
Doubtful		8
Peritoneal adhesions, tubercles, etc.		9
Stricture of sigmoid flexure		10
Ditto colon		11
Ditto rectum		11
Intussusception		24
By bands, adherent diverticula, uterine appendages, etc.		36
Total		135

From whatever cause obstruction has its origin, the symptoms are commonly so similar, that a correct diagnosis as to the exact seat of the block is not to be expected. We may, however, by careful inquiry and examination, approach near it. But whether occasioned by intestine entangled in a loop, or fissured omentum ; by a cicatrix, or simple stricture ; by a foreign body ; or by a twist contracting the gut—the symptoms do not vary much in character, though they will in degree and in the period of their commencement and sequence. Constipation and pain, vomiting, and tension of the abdomen, each and all may be present ; and should be present, to constitute the condition of absolute obstruction.

But we are of opinion that intussusception should be excluded entirely from the above general observations. The usually early and marked symptoms of invagination are sudden, often acute pain, as severe as it is sudden ; constant desire to pass motions, and perpetual attempts made to this purpose without any relief. Most commonly there is discharge of blood mixed with mucus, or pure blood in a fluid or clotted form. From no other cause of obstruction have we seen such perpetual desire to stool in the early part of the attack ; nor, with such attempts, the passage of blood and mucus. Sometimes a small quantity of feculent matter is mixed with the mucus, but often only enough to color the discharge. Intussusception, again, is the form of obstruction which occurs earliest in life. We have known it occur in an infant at the breast between five and six months. Mr. Hinton mentions a fatal case at the age of two and a half months. In men affected with intussusception, similar symptoms are observed. The disease is more rare in old age ; the oldest of which we have a record was in the fifty-sixth year.

The symptoms attendant on obstruction from other causes will vary according to the completeness of the strangulation, or block. In all internal strangulations, by bands, etc., the symptoms are usually very acute ; the pain is sudden, sharp, even agonizing occasionally ; vomiting sets in early, and is usually incessant ; the distension may not be as great as in the more slowly-operating causes of obstruction, since little food can be taken, but still the small intestine becomes much loaded ; there is generally great tenderness on pressure, for usually peritonitis is not long absent ; there is early evidence of grave constitutional damage, for the portion of intestine, tightly bound down or encircled at the strictured part, soon thickens and inflames, or may blacken and mortify.

In twists of the large bowel ; simple stricture, or cancerous contractions ; foreign bodies ; loaded intestine ; abscess of abdomen ; and other chronic causes of impediment, the symptoms may vary to some extent, and in most of these instances may present themselves gradually.

Constipation, more or less difficulty in defecation, small, long, thin or flattened motions, constitute the primary and alarming symptoms of commencing stricture. The belly becomes distended by degrees, as the obstruction increases ; pain follows upon the increase of contents ; often transient periods of diarrhœa occur. Vomiting is frequently absent till quite a late stage. Of course something depends on the position of the obstruction. If it occurs in the upper portion of the intestinal canal, vomiting occurs early in the case, and distension of the abdomen is less marked. If in the lower bowel, sickness sets in late, but great accumulation may occur in the large gut, and the peritoneal coat be in consequence ruptured before death, unless timely relief be afforded.

The examination of the general surface of the abdomen does not often convey much, if any, idea of the exact seat of the obstruction, unless it be caused by a tumor in that cavity. Occasionally, with a twist of the sigmoid flexure, the chief swelling has been observed on the left of the umbilicus ; but very little dependence can be placed on such evidence for a satisfactory solution of the exact cause or seat of the obstruction. The examination of the rectum often conveys more

[1] Association Medical Journal, 1853, p. 431.

satisfactory information. The obstruction may be often here detected by the finger, or bougie; water thrown up may be immediately returned, or a small quantity may be retained, sufficient to indicate that a stricture, not to be detected by the finger, exists higher up.

["Symptoms of diagnostic value are furnished by *examination of the abdomen.*

"As the gases and other contents collect above the occlusion, distension of the corresponding loops and of the abdomen occurs—meteorism. Abnormal gaseous products of decomposition, formed by the stagnating contents of the intestine, may also aid in its production. The meteorism is the more considerable and general as the occlusion lies deeper in the intestine. It is augmented by the occurrence of peritonitis and paralysis of intestinal muscles. Not only does the distension of the abdomen vary in intensity according to the seat of the obstruction, but it is also limited to certain regions, a relation which offers important aid in making the diagnosis of the seat of the occlusion, but which also can lead into error.

"If the lower part of the colon or rectum is occluded, the distension is often limited at first to the region occupied by the colon, the loins, hypochondria, and epigastrium, and the transverse colon especially projects like a well-defined tumor, while the meso- and hypogastrium are relatively sunken. But in such cases, as we have already said, the ileo-cæcal valve soon becomes insufficient, and the meteorism becomes general and regular. Even when the meteorism is strictly limited to the colon, the distension of the abdomen may be general. This happens when, as is frequently the case in chronic constrictions of the lower colon, its upper part is thrown into numerous convolutions, occupying not only its usual place, but also the whole meso- and hypogastrium, and completely covering the small intestine. Indeed, exceptional cases have been seen of meteorism of the colon alone, in which the hypo- and mesogastrium were more distended than the region of the transverse colon was, and therefore it was thought to be meteorism of the small intestine alone. This is the case when the transverse colon is drawn downwards to the symphysis so as to form with the ascending and descending colons the letter M.

"When the occlusion is seated in the lower part of the ileum or in the cæcum, the distension is limited to the small intestine, and the meso- and hypogastrium are usually more swollen than the region of the colon square. But considerable tympanites of the convolutions of the small intestine forces the colon backwards, and extends with general distension of the abdomen into the regions corresponding to the colon. There is one sign which is always absent, but which, on the other hand, cannot always be made out in meteorism of the colon—that is, the visible projection of a swelling running across the epigastrium, and corresponding to the transverse colon. When the obstruction is seated high up in the jejunum or the duodenum, the meteorism is entirely absent, or is limited to the epigastrium, while the rest of the abdomen seems sunken. When the obstruction remains for some time in the highest portion of the small intestine, the consecutive ectasia of the stomach may increase to such an extent that meteorism of the meso-, and even of the hypogastrium, results. The higher the seat of the obstruction, the more do we often see a sudden change in the degree of meteorism after a fit of vomiting, a fact which deserves more attention than has heretofore been given to it. I have yet to mention irregular asymmetrical meteorism, in which one side of the abdomen usually is more swollen than the other. This greater distension occupies the right side when the obstruction is seated between the hepatic bend and the upper part of the descending colon, and the left side in cases of stenosis of the rectum, and especially of ileo-cæcal or colic intussusceptions which extend into the colon or rectum."[1]]

A long tube passed up the rectum may frequently detect the actual obstruction; but it is often apt to deceive us as to the seat of the stricture. It is, however, always desirable, in all cases of obstruction, to attempt its introduction as far as possible without any force, and to inject warm water frequently and plentifully, if any fecal discharge accompanies the return of the injected fluid.

["Recently the upper portions of the rectum, and even part of the rectal end of the sigmoid flexure, have become accessible to direct palpation by the method of introducing the whole hand through the anus into the rectum. To Simon, of Heidelberg, belongs the credit of having methodically described and confirmed and perfected by numerous investigations this mode of examination, which I saw Nussbaum employ in his clinic about the year 1865, and which Maunder, in 1868, used for diagnosis of rectal stenosis. The bloodless method of this manual exploration consists in the introduction of the whole hand through the gradually distended anus during deep chloroform narcosis. Great narrowness of the outlet of the pelvis, especially in men, or an unusually large hand on the part of the examiner, may interfere with the practicability of this mode of exploration. In other cases the introduction of the hand is aided by nicking the cutaneous border of the anus in several places, and, in exceptional cases, division of the sphincter backwards in the raphe is necessary. The resulting incontinence of feces lasts ten or twelve days (Simon). After the hand has been introduced, three or even four fingers can be carried still further up into the highest part of the rectum, through Nélaton's sphincter, and

[1] Leichstenstern, "Constrictions, etc., of the Intestines," Ziemssen's Cyclopædia of Medicine, Am. ed., loc. cit.]

a short distance into the sigmoid flexure, and by raising the latter, which is allowed to move by its mesocolon, it is possible, under favorable circumstances, to reach the region of the umbilicus, as I saw Nussbaum do, and even the xiphoid process. In this way different organs in the abdominal cavity can be felt through the sigmoid flexure. The method of this manual exploration, which is always made under chloroform, appears to be without danger when carefully done—a certain amount of force is unavoidable; but yet it is by no means an indifferent operation, and it should be made use of only when there is actual need of it, when important diagnostic information can, with a great degree of probability, be expected from it, or therapeutical ends attained, as in the case of a foreign body, before the performance of laparotomy or colotomy, etc.

"Examination per vaginam may furnish important diagnostic information by showing the existence of a retro- or anteflexion of a tumor arising in the genital organs or in the wall of the pelvis, of a vaginal hernia, etc."[1]

Dr. Agnew, in referring to Simon's method of examining the rectum, says: "The benefits resulting from such violence are of so doubtful a character, and the evils which have resulted are so serious, that I feel compelled to condemn the practice as rash and revolting."[2] This view of the above method of examination would seem to be the one generally entertained both by English and American surgeons, since they entirely ignore it in their works, or else speak of it unfavorably.]

The emaciation which usually accompanies cancerous deposits in other parts, the existence of fecal fistulæ in the abdominal wall, the bladder, or the vagina, are symptoms of frequent occurrence in cancerous stricture. Hepatic pains of previous years, or months, the symptoms of former mischief about the gall-bladder, point towards the supposition that a biliary calculus may have ulcerated into the duodenum, and produced the obstruction by blocking up the canal. Concretions, the offspring of particular kinds of food, the stones of fruit, or substances swallowed under peculiar conditions of hysteria or mania, produce similar symptoms of obstruction.

The treatment of obstruction of the bowels is a question of the deepest interest. Notwithstanding the experience of recent years, it must ever be regarded with anxiety, as it will always be subject to much discussion. There is too frequently a hopeless condition when the surgeon is called in. Death occurs often so early in the scene, even in a constitution otherwise healthy, that the medical attendant has little time to propose, or the patient to acquiesce in, measures which involve life; it becomes, therefore, a matter of grave importance to decide upon rules for our guidance under such perplexing circumstances.

The subject is not a new one, and yet little notice has been taken of it in systematic works on Surgery. The detached writings of Callisen, Littre, Amussat, Phillips, Heven, Cæsar Hawkins, Curling, and others, have of late years drawn more attention to its consideration; whilst the experience derived from our hospitals, and the results of more recent operations, have to a great extent sanctioned surgical interference for the formation of artificial anus, when other medical treatment has failed.

In the management of this class of cases, purgatives should be scrupulously avoided. This is a precaution to be adhered to most rigidly at the commencement of the symptoms. But if there be one golden rule to guide us in the treatment of cases of obstruction, it is this: that opium be administered by the mouth, and aperients only by the rectum. Every rule may have an exception; but experience has taught us, that whenever this rule has been departed from, subsequent occasion for regret has arisen. In the early and more acute symptoms, small and repeated doses of calomel may be combined with opium if peritonitis be suspected, or is already well marked. Leeches and hot fomentations may be applied to the abdomen, especially if great pain and acute tenderness exist. Enemata should be used frequently and in large quantities, especially if it be suspected that the obstruction is the result of impacted feces.

[The employment of what are termed "monster-clysters" is best attained by means of hydrostatic injections in conjunction with a suitable position of the patient—that is, a position in which the abdominal pressure is as much as possible diminished — knee-and-elbow, knee-and-head, or lateral abdominal. A flexible rubber tube attached to a nozzle, for introduction into the rectum, and a funnel, for receiving the injecting fluid (warm water), is all that is required for applying this treatment. The advantage it possesses over the syringe is that we can regulate, with great certainty, the pressure simply by elevating or lowering the funnel, and again we avoid the interruption of the stream, which is not possible when a syringe is employed.

In order that the enemata may act directly upon incarcerations or invaginations, it is advised that ether, chloroform,

[1] Leichstenstern, "Constrictions, etc., of the Intestines," Ziemssen's Cyclopædia of Medicine, Am. ed.]

[2] Agnew's Surgery, vol. i.]

or opium should be previously administered to relax the ileo-cæcal sphincter, when the obstruction is situated in the lower part of the ileum.]

The introduction of the long tube may be attended by some difficulty, but if successful, secures a most efficient administration of enemata. The use of enemata may occasionally prove injurious. In a case of twist of the sigmoid flexure, the enemata injected in the usual manner were retained, and never returned. Subsequent to death, it was found that a long tube could be inserted beyond the twist into the dilated bowel; but in consequence of a flap-like entrance at the commencement of the latter, the fluid injected into it could not be returned. The enemata used in such cases should be warm water, their mechanical action being of far greater importance than their specific properties.

In the management of every case of supposed intestinal obstruction, every variety of solid food should be rigidly prohibited. Life should be entirely sustained by fluid nourishment.

When situated low down in the sigmoid flexure, or upper portion of the rectum, the obstruction will be more readily detected, as the accumulation in the larger bowel increases. In such conditions it is prudent, if practicable, to overcome the immediate effects of obstruction, by passing a small gum catheter through the stricture, and injecting warm water into the bowel; or by introducing the finger gently and slowly into the gut above, to dilate slightly the contracted part. In the latter attempt much care is necessary. The passage of the finger should not be hurriedly or hastily effected. The stricture in these parts is commonly the result of cancer; the parts are consequently thickened, often ulcerated, and brittle under manipulation. The duration of the disease has allowed it, probably, to implicate the whole structure of the surrounding gut, and has often involved the peritoneum in the diseased mass. As the bowel, from the load above, is pressed down far lower than its natural relations, the peritoneal reflexion in consequence comes much nearer the external aperture; a sudden dilatation of the diseased bowel, a rapid thrust of the finger through the obstruction, can only be effected at the expense of some laceration of the diseased tissues.

A man was admitted into St. George's Hospital, under the care of Dr. Nairne, with constipation of some days' standing. Treatment having failed to procure any action of the bowels, the author was requested to make an examination of the state of the rectum. This was found pushed down so that the orifice was on a level with the lower edge of the nates. A stricture was readily felt, within a short distance of the anus, pressed down, however, by an immense collection of fecal matter. A small gum catheter was introduced without difficulty, and allowed the passage of some fluid feces and flatus, with great velocity. The forefinger was subsequently passed very slowly through a rather resistant contraction of the bowel, the result of large deposit around it. The man shortly had great desire to pass a motion, and a copious evacuation of fluid feces took place; but while on the close-stool, he was seized with excruciating pain, which continued for some time. He died the following morning. The intestines were greatly loaded, especially the lower bowel. In the pelvis, recent effusion of lymph and feculent extravasation were observed. A small rent in the peritoneum on the anterior face of the rectum, just above the recto-vesical fold, ran through the diseased (cancerous) mass into the cavity of the gut; a rent no doubt made in the wall of the bowel during the dilatation of the stricture by the finger. Through this rent the feces had passed into the cavity of the peritoneum.

[Electricity has been employed, first by Leroy and Duchenne, in the treatment of intestinal obstruction, but as a remedy it has not been favorably received by surgeons. Péan in his recent work, "Diagnostic et Traitement des Tumeurs de l'Abdomen et du Bassin," says: "We think that this means (electricity) should be tried during the first stage, in certain doubtful cases, when the intestinal obstruction is owing to an accumulation of fecal matter, with a paralysis of the intestine, or even an intestinal invagination, but it cannot be efficacious in the majority of cases of intestinal obstruction caused by invagination or constriction." Abdominal taxis or massage is described by Erichsen as follows: "The patient is anæsthetised; he is then taken by the legs and suspended over the shoulders of a strong and tall man, who jumping up and down several times, violently shakes the inverted and unconscious patient. As the patient is hanging with his head downwards, and the other viscera as well as the abdominal are shaken up by this process, it need scarcely be said that care must be taken in its employment, and it would scarcely be safe, except in the young." This author has known the above method to succeed in one case of obscure intestinal obstruction.]

We have now to discuss the conditions under which it is justifiable to operate in obstruction of the intestines, when all other efforts have failed to procure relief.

The operations for the relief of obstruction are of two kinds. In one (Littré's), the abdomen is opened by cutting through the peritoneum. In the other (Amussat's), the intestine is opened in the loin, external to the peritoneum.

The duration of constipation is not *the positive* indication for such interference. Death takes place in three or four days, if perfect strangulation of the bowel has occurred from the pressure of a band of false membrane, or from intestine having slipped through some contracted aperture in the omentum or mesentery. In such a case, constipation is not the most important symptom. It is not *the* symptom, which of itself indicates the absolute necessity of active interference, or the hazard of delay. In common or cancerous stricture of the rectum, constipation is not often complete or continuous, although the accumulation of feces may be great. Six weeks or two months may elapse without a motion, and without fatal results from such an occurrence. Constipation here again is not alone *the* symptom which warns the surgeon to act with his knife. In constipation following peritonitis the result of injury, in habitual or other accidental constipation, the bowels may remain locked up for a month, or even two, and yet ultimately yield to treatment or time, and recovery take place. Constipation in the latter instances cannot, therefore, be taken as *the* signal for the establishment of an extraneous outlet to the contents of the bowel.

But in the more acute instances of strangulation, with vomiting, pain, and distension, complete constipation must be present to justify operative interference. In the more chronic instances of obstruction, no matter how great the distension of the intestines, so long as fecal ejections can be secured in never so small a quantity, the means to encourage them must be persevered in. No immediate operative measures should be sanctioned.

It is but rational to suppose, that in invagination of the intestine, operative interference holds out no prospect of relief, immediate or remote. The pathological conditions already discussed must satisfy the reader that such a conclusion is founded on substantial reasons. The common occurrence of invagination in early infancy; the frequent, often severe, peritoneal mischief which accompanies many cases; and the prospect of slough and separation of the invaginated portion, are the chief facts which strengthen the above conclusions. The following results are interesting: In *twenty-four cases* of intussusception, occurring at various periods of life, from two months and a half to fifty years of age, there died without any relief *thirteen cases;* some as early as three days, some as late as forty days, from the commencement of the symptoms. In the other *eleven cases*, the invaginated pieces of intestine sloughed and were passed by stool. Of these *eleven cases*, *two* died soon after the passage of the slough. *Nine cases* entirely recovered. The patients who recovered were ill for periods varying from five to thirty days respectively; their ages varied from six to fifty years.[1]

The injection of air or water into the rectum has been proposed and adopted in supposed cases of intussusception; nor can we say that such treatment has not been attended with advantage; for in well-authenticated cases with symptoms of invagination, this treatment appears to have done occasional good. The proof, however, is wanting, that actual invagination existed in such cases. This form of treatment cannot be supposed to possess any advantageous influence in the reduction of invagination of any extent or of some duration. The too indiscriminate employment of air, or of water, for the purpose of distending the bowel, with a view to reduce the prolapsus—to push it up, as it were—may act most injuriously; the peritoneum covering the intestine may be ruptured in consequence. But applied with discrimination, the use of warm water enemata alone is a measure which frequently will afford relief, temporary, if not permanent, in many conditions of constipation, and should be always had recourse to; not with an expectation that it will unravel an invaginated piece of gut, but that, if the diagnosis be incorrect and constipation depend on other and remediable causes, benefit may accrue, and perhaps recovery be insured thereby.

In the treatment of all other forms of obstruction dependent on structural derangement or organic disease, medicines are of no avail. If the obstructing cause be not removed, or if the condition of the intestine be not relieved by some effective measures, the patient will surely die, and in a comparatively short time.

"Internal strangulation," observes Rokitansky, "when diagnosed, most imperatively requires an operative proceeding, for the purpose of disentangling and arranging the intestines, and for the division of the strangulating structures."[2] Mr. Phillips, after careful study of the subject, arrived at the conclusion "that the interference by surgical operation is justifiable when three or four days have passed without any relief from ordinary means (provided the constipation be complete, and vomiting of fecal matter continue), because it affords a greater chance for the preservation of life than ordinary means."[3]

Mr. Curling is of opinion "that the

[1] These particulars are taken from cases published by Mr. Hinton, of Blaina, in an able article on "Intestinal Obstructions," in the Association Med. Journal, 1853, p. 451.

[2] Path. Anat., vol. ii., p. 54.

[3] Med.-Chir. Trans., vol. xxxi., p. 35.

success which has attended the operation of lumbar colotomy, in persons weakened by organic disease and want of nourishment, shows that the operation is not so formidable and dangerous as is commonly supposed."[1]

[Among operative procedures is to be placed the operation of puncturing the intestines by means of a fine disinfected trocar or hypodermic needle. This slight operation is admitted to be entirely free from danger, it relieves the patient of meteorism, which usually gives rise to such distressing symptoms, and although often but temporary in its action, it should always be considered when the tympanitic condition of the abdomen is extreme. Piorry[2] has shown that the instrument does not always penetrate the intestine, frequently passing between the convolutions. That it has entered the bowel may be demonstrated by applying the flame of a match to the gas escaping from the trocar. In twisting of the sigmoid flexure, this condition being frequently retained by the meteorism alone, the simple operation of puncturing the intestine may possibly permit the return of the bowel to its normal position, and the relief of the strangulation. Aspiration of the intestine, after the method of Dieulafoy, has been successful in reducing a considerable number of cases of strangulated external hernia; also in internal strangulation this method has been employed with success.]

The alternative of cutting into the abdomen for the relief of obstruction must always be regarded as a choice of evils. This is the intrinsic worth of the operation. Nothing better can be said of it. On the one hand a patient is suffering from the effects of internal displacement of intestine, which will surely destroy life in a very few days; or from a disease which will, by causing obstruction, certainly prove fatal in a few weeks, unless the displacement be set right, or the effects of the disease be obviated by an artificial outlet above the stricture.

It becomes manifest, when the anatomy of obstructions is fully considered, that one of two operations must be adopted, if relief is to be attained and life preserved; viz., cutting into the peritoneal sac, and endeavoring to remove the cause of strangulation [laparotomy]; or cutting into the colon in either lumbar region without entering the cavity of the peritoneum [colotomy].

It is next a matter of importance to consider under what conditions either operation should be undertaken; in what manner each should be performed; and what should be the subsequent treatment of patients subject to such operations.

The operation of opening the abdomen through the peritoneum is requisite for the relief of internal strangulations of the small intestine, or obstructions caused by foreign bodies or calculi, or supposed strictures of the small intestine. That of opening the colon in the lumbar region can only be useful when obstruction occurs in the large bowel.

In internal strangulation dependent on any of the causes already referred to, an opening into the peritoneal sac should enable the surgeon to ascertain the cause of obstruction; or in many cases to divide the constricting band, or dislodge the intestine from the gripe of a fissure in the omentum.

The operation of opening the peritoneum will prove less successful under the following conditions: 1st, in cases of stricture of any portion of the small intestine; 2d, in cases of obstruction from foreign bodies or calculi lodged in the intestine: 3d, in cases in which peritonitis has set in from too long neglected strangulation.

The last condition alluded to indicates the importance of early interference. The formation of an artificial anus of the small intestines offers the only prospect of prolonging life. In the removal of a foreign body, provided the operation be recovered from, it may reasonably be anticipated that the artificial anus will close. In a case in which a portion of the ileum was strangulated by small intestine coiling round it, the peritoneal cavity was opened, the strictured part was relieved, and the patient recovered.[1]

The conditions which justify this operation are, a sudden attack of pain, followed by desire to be relieved, but with no action of the bowels, and persistent vomiting; and if little or no tenderness on pressure should exist, constipation must be complete, and must have exceeded a period of twenty-four hours, in company with all the above symptoms. It must be borne in mind that the amount and character of the pain are very important symptoms in these cases. If the strangulating orifice happens to be very small, or the band very tightly applied over the bowel, so that strangulation shall be very complete in the onset of the symptoms, it will be marked by great suffering, irresistible vomiting, great anxiety and restlessness, and complete constipation. Under such circumstances, delay in operation is dangerous. We cannot afford to wait, if we hope to se-

[1] British Med. Journal, 1863, p. 111.
[2] L'Union méd., 1871, No. 109.]

[1] Prov. Med. and Surg. Journal, June 11, 1851.

cure ultimate relief; death will occur in three or four days, if some attempt be not made to remove the cause of obstruction, by opening the peritoneum.

In strictures of the rectum, sigmoid flexure, or transverse colon, the operation for relief is confined to either lumbar region, from whence the intestine may be opened, where it is uncovered by peritoneum. The advisability of this operation can generally be fully weighed before it is necessary to perform it; for there is usually less urgency of symptoms in cases which require it than in strictures higher up; and often a period of a week or two may be permitted to elapse, provided the patient be carefully watched, before operation is absolutely requisite.

The conditions which demand it are, long continued and unyielding constipation, great distension of the abdomen, and commencing irritability of the stomach, or actual vomiting.

The conditions which forbid us to anticipate recovery, and therefore should withhold surgical interference, are shrunken countenance, feeble and quick pulse, cold or clammy skin, and general tenderness of the abdomen, superadded to the symptoms enumerated above.

[Dr. Ashhurst has published a paper on "laparotomy as a remedy for intussusception and other forms of acute obstruction of the bowels,"[1] in which is given the history and result of 13 cases where this operation was performed for intussusception. Of these 13 cases 5 recovered and 8 died; 4 were under one year of age, all of whom died. There is also given a table of 57 cases of laparotomy for acute intestinal obstruction from other causes than intussusception. Of these 57 cases 18 only terminated successfully. From a study of these cases, Dr. Ashhurst draws the following conclusions:—

I. "Past experience gives no encouragement to operative interference in cases of intussusception occurring in infants less than one year old.

II. "When the symptoms present, and particularly the existence of intestinal hemorrhage, render it probable that the closeness of the intussusception will lead to sloughing of the invaginated portion, no operation is advisable; for while under these circumstances an operation would almost surely fail, there is a fair hope that separation of the invaginated mass may lead to spontaneous recovery.

III. "There may be, however, exceptional cases, in which, while there is no prospect of recovery through sloughing, bloodless remedies fail to give relief, and the patient is in danger of succumbing through exhaustion and long-continued suffering; under such circumstances, if the age and general condition of the patient do not forbid it, the question of operative interference may properly be considered.

IV. "When an operation is determined upon, *laparotomy* should invariably be preferred to either *enterotomy* or *colotomy;* these, though suitable operations in cases of congenital occlusion and chronic obstruction of the bowels, are unsuited for cases of intussusception, or other varieties of acute obstruction

V. "In cases of acute intestinal obstruction from other causes than intussusception, should milder measures fail to give relief in the course of three, or, at the most, four days, laparotomy should be unhesitatingly recommended, and may under such circumstances be resorted to with a reasonable hope of success."

The abdominal surgery of to-day can scarcely be contrasted with that of earlier times. The antiseptic treatment has certainly greatly modified the results, and a comparison of the early and late operations is very much in favor of the latter. Nussbaum remarks that "the difference between the old times and the present simply consists in this: that we have learnt the sources of the danger." Mr. Spencer Wells, who has lately performed ovariotomy for the one thousandth time, has reduced his mortality from 25 per cent. to 11 per cent. In his late operations he had adopted antiseptic precautions. With such results before us, it would seem, that when the diagnosis of intestinal obstruction is clearly made out, an early and strictly antiseptic operation may be undertaken by the surgeon with a fair prospect of its terminating successfully.]

The operation of opening the peritoneum for the examination of strangulated or obstructed intestine, and for the formation of an artificial anus in the walls of the abdomen, was first advocated and adopted by M. Littré, in modern times at least: though the abdomen had been opened by Pillore, of Rouen, in 1776, and an artificial anus formed in the cæcum, for cancerous obstruction of the rectum.[1] The operation of M. Littré is thus described: "Il faudrait faire une incision au ventre et recoudre ensemble les deux parties après les avoir rouvertes, ou du moins faire venir la partie supérieure de l'intestin á la plaie du ventre, que l'on ne refermerait jamais, et qui ferait la fonction d'anus."[2]

[1] American Journal of the Medical Sciences, July, 1874.

[1] "On Artificial Anus," British and Foreign Medical Review, vol. xviii., p. 452. The author begs to acknowledge the assistance he has received from the perusal of this most able essay.

[2] Hist. de l'Acad. des Sciences, 1710, p. 36.

This operation, originally proposed for the relief of imperforate anus, is that to which we can alone have recourse to relieve any form of internal strangulation, or obstruction dependent on mischief *confined to the small intestine.*

It is not desirable to adopt this operation in obstructions *confined to the large intestine.* The operation which insures the opening of the ascending or descending colon, commonly termed the operation of Amussat, is alone to be adopted in these cases.

The operation for opening the peritoneal sac, to explore its contents, requires but little to be said respecting the method of proceeding. The surgeon having decided upon the operation, should have the patient placed on a conveniently high bed or table. The bladder should be emptied by a catheter. The incision should commence an inch below the navel, and be carried down about four inches, or sufficiently low to allow of the obstruction being thoroughly investigated.

The first incision should extend down to the linea alba, which should be next carefully cut through at one point, that the peritoneum may come into view. A broad director should now be passed under the conjoined aponeurosis, and the latter further divided, so that the peritoneum be fully exposed. A small opening must be carefully made through the latter, sufficient to allow the introduction of the first and second fingers. These being passed into the sac of the peritoneum will serve the purpose of a director, and upon them a blunt-pointed bistoury can safely be introduced, in order to extend the incision in the peritoneum, either upwards or towards the pubes, as necessity or convenience direct.

When the abdomen is laid open, search must be made, slowly and carefully, for the constricted piece of intestine. The distended bowel may be followed down, if there is difficulty in at once arriving at the point of obstruction, until the cause of mischief is reached. It is impossible here to enumerate all the difficulties which may now be encountered; it must be sufficient to point out that bands of lymph or adhesions should be carefully separated, or divided; or the strangulated intestine withdrawn from any loop or fissure in which it may have become entangled: or should a foreign body or calculus cause the stoppage, it should be removed by opening the intestine, subsequent artificial anus being the necessary result; for the edges of the wound of the bowel must be stitched to the margins of the external wound, and care taken that feculent matter be not allowed to enter the peritoneal cavity.

Except in the latter instance, the wound of the abdomen should at once be closed; the edges had best be drawn together with silver-wire sutures. The subsequent treatment of such an operation should consist of perfect rest and quiet; warm light applications to the abdomen; and opium administered by the mouth in one- or two-grain doses every four hours, as long as the patient does not sleep. Sleep should not be disturbed to administer a dose due: for sleep alone, in these cases, contra-indicates the repetition of opium. Its internal use should be continued until the patient is quite restored to convalescence, and the motions are natural and regular; for the continued administration of opium to this period has been found not to hinder a natural and healthy action of the bowels. Its effects are most instrumental towards recovery.

[Nussbaum, in an address before the Munich District Medical Society (Aertzliches Intelligenz-Blatt, January, 1880), says:—

> Among the principal dangers attending this kind of injury (peritoneal surgery), must be reckoned the great susceptibility to the influence of cold which the peritoneum is known to possess. This enormous, constantly moist surface, when exposed, leads to such a rapid cooling of the blood, that immediately reflex paralytic conditions of the heart, and even death, are threatened. The second source of danger is the almost unlimited power of absorption which the peritoneum possesses; and thus any exudation into it which may have undergone unhealthy metamorphosis is liable to bring about rapid and severe septic conditions. Thirdly, peristaltic action, by means of which any exudation that gets into the peritoneal cavity, an enormous surface, is stirred up and smeared over the whole of its contents. Fourthly, movements of respiration, the rise and fall of the diaphragm and small intestine aiding the absorption. Fifthly, peritoneal wounds are dangerous because of the little spaces which everywhere exist, into which secretions may find their way and lie hidden and decompose. And, finally, there is the danger of infection through the ill-smelling intestinal gases, which especially favor sepsis; and even if the bowel itself be not injured, gases find their way in and out. On the whole, therefore, we see that there were good grounds for the dread which has hitherto always been felt of peritoneal injuries, whether accidental or applied by the surgeon for surgical purposes. Since, however, the causes of this great danger have come to be understood, and the means by which they may be overcome have been learnt, the indications for operations and prognosis have been greatly modified.[1]]

When an obstruction is known to be situated in the rectum, or suspected in the sigmoid flexure, the descending colon

[1] Med. Times and Gaz., May 22, 1880.]

must be opened; when suspected in the transverse or descending colon, the ascending colon, or cæcum, must be cut down upon. The exact seat of stricture may occasionally be ascertained—if in the rectum, by the introduction of a finger or a bougie; if in the sigmoid flexure, it is often made manifest by swelling, thickening, or hardness of the part. The stricture is less evident externally, when seated in other portions of the colon. It then often becomes mere speculation at which part of the bowel the obstruction is seated.

The chronic nature of the symptoms, the slow accumulation of feces, point to the large gut as the seat of mischief; but whether the obstruction lie in the transverse or descending colon, it is generally impossible to decide. Under such circumstances, the only safe course would be to open the ascending colon.

The operation of opening the colon was first advocated by Callisen,[1] but attempted by him only on the descending colon. M. Amussat modified it by extending it to the ascending colon.

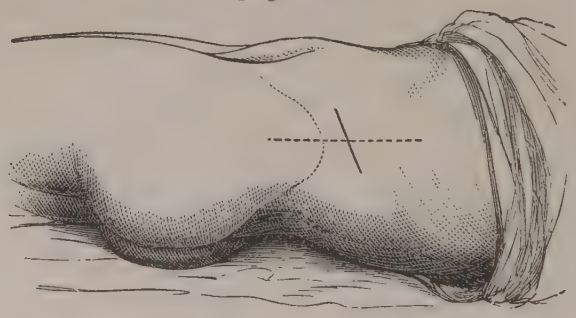
But to M. Amussat is alone due the credit of having revived the operation—an operation not only fallen into disuse, but condemned as dangerous and impracticable by some very modern writers.

The virtue of this operation is, that it enables the surgeon to expose the intestine and open it, where it is uncovered by peritoneum, and where it lies in front of the quadratus lumborum muscle, and merely separated from that muscle by cellular tissue. The situation of the external incision, on either side, is in the lumbar region, between the last rib above, the crest of the ilium below, a vertical line running from the end of the rib to the crest of the ilium in front, and the edge of the longissimus dorsi behind. The colon in this space is fixed to the abdominal wall by the reflexions of the peritoneum, and lies loosely in contact with the quadratus lumborum. The kidney is situated rather above the seat of the incision. There is no meso-colon here; and if the colon be much distended, the cellular space between the folds of peritoneum will be very conspicuous. It is at this part that the intestine should be opened.

Callisen advocated a vertical incision for this purpose in the loin; Amussat has judiciously recommended a transverse one. The advantages are thus fairly stated: 1st, that it makes the operation easier and more certain, and avoids the danger of dividing the lumbar vessels and nerves; 2d, that it facilitates finding and opening the intestine without wounding the peritoneum; and 3d, it enables us to establish the artificial anus more anteriorly.[1]

The incision should commence in front of the longissimus dorsi, and be carried forwards to the extent of about six inches.

[Fig. 392.



Line of incision for lumbar colotomy. Dotted line indicates situation of descending colon. (Erichsen.)]

The integuments having been divided, the muscles are to be carefully cut through until the intestine is exposed. This is not a difficult or troublesome proceeding. The intestine, especially if loaded, presents its muscular surface in the bottom of the wound, uncovered by peritoneum. The bowel should be at once hooked up by a curved needle; two or more points should then be secured by threads to the margin of the wound, and the gut opened. Usually a great gush of fluid feculent matter takes place; ample provision should therefore be made to secure it as it flows out, to prevent the bed becoming greatly soiled, which would be the case in a few seconds, if suitable basins be not at hand to apply to the edge of the wound.

The intestine should be allowed to empty itself gradually. Usually the relief to the patient is at once very considerable; but he should be steadily watched and well supported, as faintness

[1] Systema Chir. Hodiern., tome xi., p. 842, Hafniæ, 1817.

[1] Amussat's First Memoir, p. 241.

is very apt to follow upon the rapid evacuation of the long distended bowel; or should peritonitis have set in prior to the operation, the patient will soon sink.

Should the patient survive the operation, the treatment of the wound is of next importance. In the first instance much inconvenience and even some distress may be experienced from prolapse of the gut through the artificial opening; especially if the latter be a free one.

But as the wound in the integuments has a natural tendency to contract as time advances, and the margins of the intestinal opening become adherent to the former, the prolapse will gradually diminish in proportion to the contraction, and will usually cease ultimately when the orifice becomes fully contracted. Indeed, should the patient's life be prolonged, it will be found as a rule, that the surgeon's attention must be directed towards maintaining the freedom of the artificial opening sufficiently to ensure the escape of the contents of the bowel. In the first instance the escape of fecal matter through the wound may be controlled by the use of an ivory ball or plug attached to a small shield, on which a piece of India-rubber sheeting may be placed, and fixed in its position by a bandage. As the wound continues to contract, it will be found best to substitute for the ivory plug a piece of sponge-tent: this may be introduced and worn in the opening day and night, but changed morning and evening. Its use has been found to effectually control the escape of air and fecal matter.

Sometimes the patient will experience discomfort from the accumulation of feces between the strictured portion of the bowel and the artificial opening; or from the contents of the bowels becoming too solid to pass freely through the aperture, and therefore care must be taken to regulate the action of the bowels with gentle aperients as circumstances indicate.

The operation of opening the colon in the lumbar region is an important measure, not only for the prolongation of life in cases of total obstruction from stricture of the rectum; but also for the mitigation of suffering in cases of ulceration and stricture of the rectum without actual obstruction. In such cases excruciating pain is often experienced, when the bowels act, from the passage of fecal matter over the ulcerated surface; and it has been found that by establishing an artificial opening above the seat of disease, and thus diverting the passage of feces, and leaving the stricture at rest, great comfort has been conferred upon the sufferer.

Mr. Curling was the first to advocate this operation under such circumstances, and he has frequently adopted it with much relief to the patient's sufferings while life lasted. He recommends previous to the operation that the bowel should be injected with fluid in order to distend it to some extent, as when in a distended condition, the bowel is more readily detected and secured than when empty and contracted.

Mr. Holmes[1] has published the particulars of a case in which he opened the descending colon for the relief of a patient in whom there was a fistulous communication between the sigmoid flexure of the colon and the bladder. The symptoms were immediately relieved, and the patient remained free from the passage of fecal matter into the bladder for about fifteen months, when feces again appeared in the urine. He shortly after this died; and on post-mortem examination it was found that besides the communication between the sigmoid flexure and the bladder, there had formed a more recent communication between the bladder and the cæcum.

Mr. Curling has either himself performed or recommended the operation of opening the descending colon in seventeen cases of diseased rectum, or obstruction of the bowels. In ten of these cases the patients survived over periods varying from two to eighteen months. In a case under the care of the author, and in which complete obstruction had existed nearly three weeks, the patient has survived the operation over two years and a half. The artificial opening has always shown a tendency to close, but has been kept open by the use of sponge-tent. For some time past a portion of the feces has passed the natural way.

[The following comparison of Littré's and Amussat's operations is given by Erichsen.[2]

When we compare the different operations that have been proposed for the formation of an artificial anus, it will be found that Callisen's, as modified by Amussat, is the one to which preference must be given; for by it alone the peritoneum is not wounded, and thus the inflammation of that membrane, which is a necessary and often a fatal consequence of the other operations, is avoided. Besides this advantage, which is of the very greatest importance, Amussat's operation presents several other claims to our notice. As only one side of the colon can be drawn forwards, and not a knuckle of it, as would be the case if the small intestines were operated upon, it is evident that the spur-like process, which has been described by Dupuytren, must exist to a very small extent, and, consequently, if the artificial anus should ever become useless, the natural passage for the feces having been re-established, it could readily be closed up. If, however, the peritoneum should be accidentally wounded in the attempt to reach the colon, from behind,

[1] Trans. Med.-Chir. Soc., vols. xlix. and l.

[2] Science and Art of Surgery, vol. ii., p. 668.

even then this operation would be preferable to that of Littré; for, the cavity of the abdomen having been opened at its most depending part (in the recumbent position), the fecal matters would have much less tendency to be effused into it than if it were opened in front. In respect of not wounding the peritoneum, this operation closely resembles that of puncturing the bladder above the pubes and below the reflexion of that membrane. There is, however, one important difference between the two operations, which may influence the result; in the one case, as the patient lies upon his back, the urine has a tendency to stagnate in the wound, being obliged, in order to escape, to mount against its own gravity, whilst in the other case, the fecal matters find a ready exit from a wound situated in a depending part.

"Cæsar Hawkins has collected and analyzed 44 cases in which an artificial anus has been formed by opening the intestine; in 17 of these the artificial anus was made through the peritoneum, and in 27 behind that membrane; but for various reasons, which are stated at length in the paper, Hawkins excludes 5 of the cases of peritoneal section, leaving only 12 to compare with 26 cases of operation behind this membrane. Of the former he finds that 7 died and 5 recovered; the recoveries amounting, therefore, to only forty-one per cent. in the cases of this category, whilst of the 26 cases where the peritoneum was uninjured, 10 died and 16 recovered; the proportion of recoveries in the cases of this category, amounting to sixty-one per cent. Though the large intestine was opened in all these cases, the operation was performed on the *right* side in 10 instances; in 4 cases the right colon and cæcum were opened through the peritoneum, and of these all died; whilst of the remaining 6, in which the right colon was opened behind the peritoneum, 4 recovered. The preference, therefore, as Hawkins observes, on the *right* side, is certainly due to the lumbar operation. It is remarkable, however, that in the operation on the *left* colon, the results were somewhat different; for, of 8 cases in which this intestine was opened through the peritoneum, 5 recovered and 3 died; whilst of 20 cases in which the lumbar operation was performed, 11 recovered and 9 died. Hawkins observes, that the inequalities of the numbers appear, however, to leave the question as to the mode of operating on the descending colon still undecided; and that an operator is justified in selecting whichever situation he thinks best for the formation of an artificial anus on the left side of the body; still, for the reasons that have already been given, there can be no doubt whatever that Amussat's is very decidedly preferable to Littré's operation. In those cases in which death has resulted from Amussat's operation, peritonitis does not appear to have exercised any material influence; and the fatal result seems rather to have depended on the influence of previous disease on the constitution of the patient, or on the changes taking place in the diseased bowel, than on the operation itself, which appears occasionally to have been uselessly done at the last extremity. We should, therefore, have less hesitation in performing the extra-peritoneal operation in an early stage of those cases in which it is called for, than we should if the section itself were attended with any serious risk to the patient's life."

Nussbaum[1] "thinks that a small opening, just large enough to let out fæces, is all that is required at first, for often, after tension of the distended intestines has been relieved, the twist will right itself; or if the obstruction be due to invagination, the gut will slough and come away. The opening is then allowed to close; but if a cure cannot be effected, the opening should be enlarged, and a permanent artificial anus established."]

The Operation of Tapping; Paracentesis Abdominis.

When the abdomen becomes inconveniently distended with fluid, contained either in the peritoneal sac or in an ovarian cyst, it is desirable to relieve the patient by tapping the cavity in which the fluid is lodged.

Previous to the operation, the patient may be placed upright on the edge of a chair, or recumbent on the side of a bed. A broad towel, warmed, should be passed round and above the umbilicus, and a second one below; the ends of these towels being held behind the patient, to be tightened as the fluid escapes from the abdominal cavity, in order that a certain amount of support be afforded to the viscera when the whole of the fluid is abstracted. Previous to the introduction of the trocar, it should be ascertained that the bladder is not distended with urine. A small incision should first be made through the skin, about two or three inches below the umbilicus, just sufficient to permit the passage of the cutting surfaces of the trocar without injury to the skin. This proceeding allows the trocar to be passed readily into the abdomen, and is less painful than if the trocar is thrust through the integument. The trocar should be pushed nearly up to the hilt of the canula, and the stilette then withdrawn, care being taken that the canula does not slip out after it. The fluid will now escape freely if serous in character, and the cavity will soon be emptied.

If the patient become faint during the flow of the fluid, a finger may be applied to the orifice of the canula to arrest the escape, while some stimulant is administered, and until faintness passes off. The common trocar, with short canula, is the

[1] Op. cit., and Med. Times and Gaz., May 22, 1880.

simplest implement to use in this operation, and as efficacious as any; but of late a tube of India-rubber has been adapted to the canula, so that the fluid may be carried to a basin at the foot of the chair or bed which supports the patient. The choice of the instrument is a matter of fancy; the original and most simple trocar is as efficacious and as convenient as the most modern complicated one.

It sometimes happens, that after a certain quantity of fluid has escaped, the flow suddenly ceases, while there is still much remaining in the cavity; this is occasioned, probably, by intestine or some other substance coming in contact with the inner extremity of the canula; the obstruction may be remedied by either moving the position of the canula, or introducing the blunt-pointed but perforated tube, with which each case of trocars should always be provided.

The large accumulation of fluid in the cavity of the peritoneum, or in an ovarian cyst, usually pushes the anterior abdominal wall so far forward that a considerable interval intervenes between it and the surface of the intestines; so that when the trocar is introduced, there is little risk of wounding the bowels. This is, however, an accident which occasionally happens, and therefore it behoves the surgeon to make a very careful examination of the surface of the abdomen, before proceeding to operate; if any tympanitic resonance be detected near the umbilicus, or below it, the operation had better be postponed or avoided. Mr. Gay exhibited, at the Pathological Society, a specimen of a portion of the jejunum, which had been punctured in the operation of tapping, in a case of ascites; but the patient survived the accident, and died three months afterwards, apparently from the disease which produced the ascites.[1] The wound caused by the trocar should be dressed with lint and plaster, and a bandage applied over it, round the belly. In a few days the parts have usually healed.

DISEASES OF THE RECTUM.

By Henry Smith, Esq.

Revised by John H. Packard, M.D.

In the following essay on Diseases of the Rectum I have treated the subjects in the order of their frequency and importance: Hemorrhoids; Prolapsus; Fistula; Ulcer; Stricture; Cancer; Polypus; Pruritus; and Neuralgia. Nothing has been said in reference to malformations of the anus and rectum, as this subject is considered in the essay on the Surgery of Childhood.

[It may perhaps be well to prefix to this essay some general remarks on the examination of the rectum. And first it may be said, that the surgeon should never be content with anything but a thorough exploration. An affection of the margin of the anus, or just within the orifice, may depend upon congestion or other serious trouble above.

Sometimes the simple introduction of the finger may serve to detect a swollen, congested, and even hemorrhoidal state of the bowel. In health, the skin about the anus is loosely puckered into radiating folds, and quite sensitive; but with slight, steady pressure, the point of the oiled finger may be passed in through the ring of the external sphincter, and then through the narrower ring of the internal, when it may be freely moved about over the smooth, firm, moist mucous membrane of the rectum proper. In some persons, if the finger is pushed far up, its tip comes in contact with a more or less transverse fold of the lining membrane, constituting a sort of imperfect valve. Very little uneasiness—nothing that could be called pain—should be induced by the manœuvre in a healthy subject.

As to the position of the patient, he may either stand up in front of the surgeon, and lean forward over the back of a chair, or he may kneel on a bed, close to its edge, with his shoulders resting on his folded arms. Or he may lie on a bed or operating table, on his left side, his left arm behind his back, so as to make his

[1] Pathological Trans., vol. ii., p. 203.

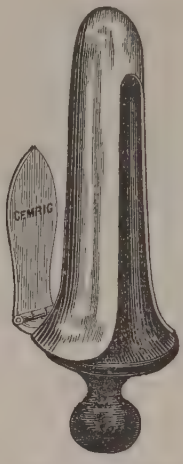
shoulders semiprone, and with his right knee drawn up against his abdomen. This latter is much the best position for the introduction of the speculum.

Rectal specula are of various kinds. They are generally made of the metallic alloy known as pewter, or Britannia metal; but glass is occasionally used. It is not necessary to have them of various sizes. A very convenient form is the dome-headed (fig. 393), sometimes made

Fig. 393.

Dome-headed speculum.

Fig. 394.



Dome-headed speculum, with handle.

with a hinged handle (fig. 394). Dr. T. B. Reed, of Philadelphia, has devised one with a glass slide or window in the fenestra (fig. 395). Another form, recommended by Allingham, is shown in fig. 396. After the introduction, the wooden plug is withdrawn, and part of the circumference of the rectum and anus is displayed to view. Some surgeons prefer the bivalve speculum (fig. 397), which is

Fig. 395.

Reed's speculum.

Fig. 396.

Allingham's speculum.

Fig. 397.

Bivalve rectum speculum.

introduced closed, and then opened by pressing the handles together.

Much advantage is sometimes gained by the use of a head-mirror (such as laryngoscopists use), to throw the light directly upon the parts; the surgeon thus avoids the shadow of his own head, and the light is concentrated. Sometimes a degree of privacy, otherwise unattainable, is thus secured.

In women, the lower end of the bowel can often be everted satisfactorily for examination, by means of two fingers passed into the vagina and curved backwards so as to press against the recto-vaginal septum.]

Hemorrhoids.

It has been the custom of surgical writers, when describing hemorrhoids, to divide them into two distinct kinds, namely, external and internal. This is a classification from which it is perhaps not well to deviate; for although many instances are seen where it is impossible to say whether the disease be internal or external,—and, pathologically speaking, hemorrhoidal tumors, wherever situated, are essentially constituted of the same morbid elements, viz., an enlargement of the vessels of the rectum, and an infiltration of their connecting tissues,—still circumstances which exist, or which occur, in connection with this disorder so modify the pathological features, that in numerous instances there is a wide and well-marked distinction between those hemorrhoidal tumors seated outside, and those involving the gut within the sphincter.

I shall therefore adhere to the classification, and first speak of—

External hemorrhoids, which are situated at the verge of the anus outside the sphincter, and consist of one or more tumors, composed at their first formation of

dilated vessels. As the disease increases, from various irritating causes, the sensitive skin around the anus becomes thickened, the cellular tissue is indurated and infiltrated, and the veins are expanded. By degrees the swelling becomes larger and harder, and does not give much annoyance when the parts are in a quiescent state; if, however, they become attacked with inflammation, the tumor increases much in size, the blood in the vein becomes coagulated, and not unfrequently the vessel gives way, allowing the coagulated blood to escape into the surrounding cellular tissue, where it will form a distinct sheath for itself. In the course of time the inflammatory action subsides, the blood becomes absorbed, and the tumor diminishes in size or wholly disappears. If, however, the same irritating causes recur, and no effectual treatment be adopted, the tumor again increases, the skin becomes thickened, and the cellular tissue more extensively infiltrated; and in this way distinct and permanent tumors are formed around the anus, which sometimes reach a large size, consisting mainly of thickened integument and cellular tissue, enclosing veins which are at times capable of distension and repletion. In their quiet state these tumors are distinctly external; but when increased in size they may encroach upon the cavity of the rectum and be covered with mucous membrane, and thus be partly internal. Coexistent with this state there is not unfrequently a very œdematous condition of the cellular tissue and mucous membrane at the verge of the anus.

With regard to the actual structure of these hemorrhoidal tumors, it will be found on examination that they are composed of thickened integument, infiltrated cellular tissue, and in most cases of one or more dilated veins; if the part is at perfect rest and has not been lately inflamed, there may be distinguished nothing beyond infiltrated tissue and thickened skin; but on cutting into an external pile, which has been somewhat irritated, or is increasing in size, there will be found either a vein considerably dilated and containing semi-coagulated blood, or the blood will have escaped from the vessel, and have become either extravasated into the surrounding cellular tissue, or have formed for itself distinct cellular sheaths. This coagulation of the blood is the reason why an incision into an external hemorrhoidal tumor, after having become inflamed and swollen, is scarcely ever attended with bleeding; it is one of the main pathological features in this form of tumor, and far different from what obtains in instances of the internal affection.

These external hemorrhoids vary much in size, the swellings being sometimes not larger than peas, while at other times they are the size of a walnut. Their presence is accompanied with unpleasant symptoms: as irritation; pain when at the closet; and a sense of bearing down, even when they are in a quiescent state: but the main source of suffering is their disposition to become suddenly enlarged and inflamed; which occurrence will arise from allowing the bowels to become constipated, from the straining attendant upon a stricture of the urethra, from excess in food and drink, or from exposure to damp and cold. Under these circumstances, the tumor, which has been hitherto small and flaccid, becomes much swollen, distended, and livid in color. From the peculiarly sensitive character of the skin at the anus, this distension is accompanied with the most exquisite pain; and it is remarkable to witness the complete prostration with which the most powerful man is overcome when suffering from acute inflammation of external piles, and especially when the symptoms have been allowed to go on for some days without the proper means of relief being afforded, either from obstinacy on the part of the patient, or from insufficient pathological knowledge on the part of the medical attendant.

With regard to the causes which produce this form of hemorrhoids, there is every reason to believe that the same circumstances which tend to the production of external, induce the internal affection as well; and therefore this description will apply to both. It appears that there is in some persons an hereditary disposition to hemorrhoidal affections; and we shall every now and then see father and son, or mother and daughter, suffering one after the other in the same way. Possibly, however, this may be owing to similarity in habits, certain of which undoubtedly much more than others induce these affections. Thus, those who have to sit continually at the desk and take little walking exercise are very liable to them; those too who have to stand long in certain positions, as dentists and hair-dressers, are remarkably prone to hemorrhoids. The great source of hemorrhoidal affections, however, is anything which prevents the healthy return of the blood from the vessels of the rectum. And thus it is that congestion of the liver, or other obstructive disease of the same viscus, is frequently associated with these affections. A constipated state of the bowels, both from the mechanical effect produced upon the vessels, and from the straining efforts necessary, is found to be the cause in a vast number of cases; the pressure also of the pregnant womb, and of ovarian

tumors, produces hemorrhoids. In other cases, the irritation caused by the frequent taking of aperient medicines is reasonably considered to be productive of the first symptoms of the disease. Violent horse-exercise, indulgence in the use of highly-seasoned dishes and other indigestible food and strong wines, together with immoderate sexual intercourse, which determines the blood more freely to the pelvic region, are each fertile sources of hemorrhoidal affections. And it is highly necessary, before any treatment is commenced, to inquire carefully into the peculiar habits of the patient.

The treatment which should be adopted for the removal of this affection must be conducted upon the ordinary principles of surgery. In the more simple cases, little beyond a strict attention to ablution, to the regular action of the bowels, and to the avoidance of those causes which are known to produce the affection, will be necessary. If the bowels are inactive, a draught of cold water before breakfast, or the use of brown bread, with a moderate amount of walking exercise, will in many cases beget a healthy tone in the intestinal canal; if, however, aperient medicines are needed, they should be of the mildest description. The compound rhubarb-pill in doses of five grains, taken occasionally before dinner or before going to bed, is a simple and unirritating aperient. A teaspoonful of the confection of senna is also a useful and efficient aperient. [Senna leaves, treated with ether to remove the resinoid constituents, may be given in teaspoonful dose. The "compound liquorice powder," a German prescription, containing senna, liquorice, and fennel, is also an excellent laxative. Some practitioners have obtained good results from the administration of glycerine in f℥ss doses, thrice daily. The powdered leaves of *teucrium scordium*, or water germander, have been also recommended.] If there be much irritation about the anus, an occasional dose of calomel should be taken, either before or in conjunction with these medicines. At the same time that great care is taken to provide a healthy action of the bowels, local remedies should be made use of. The ordinary lead-lotion, or one made of one or two grains of sulphate of zinc to an ounce of water, should be applied to the parts morning or night; or if a more powerful astringent application is required, the patient should use the compound gall ointment, which is an admirable agent. By these means, and by careful attention to diet, most of the ordinary cases of external piles presented to our notice may be cured, or so relieved that they will hardly excite attention.

If, however, one or more of these tumors become enlarged and inflamed, a much more energetic treatment is required; for there is in such cases very great suffering, both local and general. If there is much swelling, and the parts are exquisitely sensitive, the patient must be confined to bed, leeches should be applied to the part, and the bleeding should be encouraged by warm fomentations; and subsequently poultices made either of warm bran or of bread, into which half a drachm of laudanum is dropped, should be applied, and changed from time to time. Opium should be given internally; and as soon as relief from pain has been procured, the bowels should be thoroughly cleared by a saline purgative. The subsequent employment of a lotion composed of liquor plumbi diacet. dil., liquor ammoniæ acetatis, and spirits of wine,—one ounce of each of the latter to six ounces of the former,—will cause a shrinking and collapse of the swelling. [Ice, or ice-cold water, is very comforting in some cases, but requires caution in its use.]

Not unfrequently, however, the surgeon is called to a case where most or all of these measures have been tried, and yet the patient is suffering acutely; and on examination it will be found that on one side of the anus there is a tumor of a circumscribed form, of a blue color, and in a state of great distension. In such an instance, the suffering is produced by the accumulation and coagulation of the blood; and the proper treatment is to puncture the swelling freely with a lancet: there is an escape of coagulated or semi-fluid blood, with almost immediate relief to the painful symptoms. The subsequent application of cold water, or the lotion above mentioned, to the parts freely, will cause an almost entire removal of the disease. If, however, there is much loose and thickened skin over the site of the swelling, it should be removed with sharp scissors, after the part has been punctured.

After repeated attacks of this nature, the anus becomes surrounded with distinct tumors, more or less pendulous, and liable to become swollen and inflamed; for this state of things a surgical operation is required. It is, however, a simple one, and consists in the removal of these excrescences by sharp curved scissors. As the patient kneels upon a chair, or lies upon his side, the surgeon lays hold of each tumor with a hooked forceps, and excises it, with the scissors placed flat upon the skin. Chloroform is rarely necessary; but if the patient is exceedingly timid, the parts may be benumbed with ether [or ice] and thus much pain may be escaped. [The pain of such a procedure is certainly sufficient to warrant the use of an anæsthetic in every case where the

patient desires it. Few persons have the self-control to submit to a cutting operation without involuntary movements of avoidance, which would be apt to greatly embarrass the surgeon.] There is generally very little bleeding, especially if great care be taken not to snip any of the mucous membrane.

Simple as this operation is, it may in unsurgical hands be so mismanaged as to bring about serious results. If too much of the lax skin around the anus be taken away at the same time that the tumors are excised, the parts in healing will cicatrize, so that severe contraction of the anus may follow, and the patient be placed in a most miserable plight.

The same effect is likely to be produced if the mucous membrane at the verge of the anus is interfered with to any great extent: therefore, unless there is an absolute necessity for the step, this membrane should not be cut, and only the external hemorrhoids, with portions of the redundant integument, should be excised.

Internal hemorrhoids are more frequent, or, at all events, are more often presented to the notice of the surgeon, because they are productive of much more distress, and more serious consequences are liable to result from them than from the affection situated externally: and here it will be as well to mention the symptoms which are produced by them, and which are local and general.

The first local symptom which attracts the notice of a patient suffering from internal piles is, in many cases, a more or less profuse attack of hemorrhage, which may not recur for some weeks or months, but which may persist; more or less weight and uneasiness are felt at the seat; and in course of time there will be considerable pain when the bowels are being evacuated. As the swelling or swellings increase in size, the evacuation of the contents of the rectum will be more difficult and more painful; straining efforts are necessary; hence the hemorrhoidal tumors become protruded on each visit to the closet. [This protrusion is greatly favored by the size and shape of the hole in the seat of the water-closet as generally constructed. It is well, therefore, to advise the patient to provide himself with a board, about an inch thick, ten inches wide, and eleven in length, having an aperture four inches by eight, the edges of which should be well rounded and but slightly bevelled. By placing this over the ordinary water-closet seat, straining is in a great degree prevented. This may be readily used at home, and the advantage gained fully compensates for the trouble of carrying it in travelling, etc.] At the earlier periods of the disease they may be with facility returned; but as time wears on, the pain attending defecation becomes more severe, and the process of returning the piles becomes more difficult. Not only, however, do they protrude at these times, but if the patient neglects advice, the tumors come down below the sphincter whenever he takes walking exercise, the constriction caused by the muscle produces congestion in the piles and extreme pain, which is only relieved by their reduction or by a spontaneous flow of blood, which, however, occurs at most inopportune periods. In addition to these symptoms, there is pain and uneasiness felt in the loins and down the thighs, more especially in females, who very often suffer most acutely, and not unfrequently have their sufferings referred to that prolific storehouse of morbid phenomena, the womb. There is, moreover, a considerable discharge of mucus, or muco-purulent fluid, from the anus; the bladder is rendered at times very irritable, and retention of urine not unfrequently takes place.

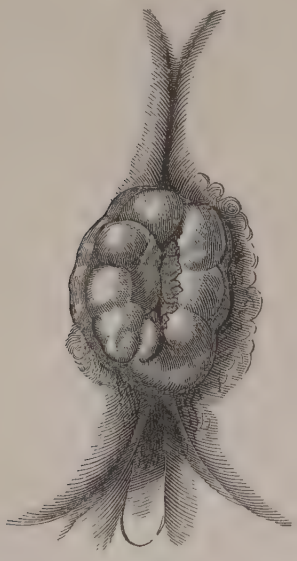
Patients who suffer from internal hemorrhoids are liable to get them inflamed from some exciting cause, such as an excess at the table, or great irritation of the bowels, and then the symptoms are extremely severe; the tumors protrude beyond the anus, and become constricted by the sphincter. Violent pains are experienced in the pelvic region, and there is a high state of constitutional disturbance, denoted by flushed face, furred tongue, rapid and wiry pulse, and extreme restlessness. If these symptoms are not relieved either by the accidental induction of bleeding, or by surgical assistance, the congestion and inflammation increase, and to such an extent that mortification of the hemorrhoidal masses ensues, and thus is produced a natural cure; but, on the other hand, it is not desirable to encourage this rude attempt at cure, for death may occur from the violent action set up. Dr. Bushe mentions having seen such a case occur.

When internal hemorrhoids have existed for a length of time, the general health becomes much influenced; the patient complains of indigestion, flatulence, and inability to follow his ordinary occupation or amusement; moreover, if, as is frequently the case, the disease be attended with periodical bleedings, the face becomes blanched, the pulse weak and rapid, and other well-known symptoms of loss of blood ensue. This is the most serious condition connected with hemorrhoids of long standing, and hence the reason why it is most important to adopt the proper treatment at an early period of these affections.

Internal hemorrhoids present various appearances. On making an examina-

tion of a patient who suffers from the milder form of the affection, the veins of the lower extremity of the rectum just within the anus will be found enlarged and distended, forming small fusiform tumors of a deep-blue color, covered by a somewhat thickened mucous membrane. In other instances, and especially where the patient complains of bleeding and sense of weight, with scarcely any protrusion, the inferior extremity of the rectum, for an inch or more, will be found highly congested and vascular, the mucous membrane having here and there distinct patches of morbid vascularity, from which, through a speculum, which it is necessary to use in such cases, blood of an arterial color will be seen to issue. This is the condition which the late Dr. Houston, of Dublin, likened to the diseased lining membrane of the palpebræ in cases of chronic conjunctivitis. In the majority of instances, however, of internal hemorrhoids, one or more distinct tumors of a rounded or oblong form will be seen to fill up, as it were, the orifice of the anus. In some cases their character and size can be ascertained by an ordinary inspection; but it is always best, in order to arrive at a proper diagnosis, to throw up an injection of warm water, and allow it

Fig. 398.



Internal hæmorrhoids surrounded by external hæmorrhoids.

to be discharged before the examination is made. By this means the tumors are brought fairly down. There are frequently two or three distinct tumors, varying from the size of a cherry to that of a walnut. In one case, the diseased part presents a bright red appearance, easily bleeds when touched, is sessile and not very raised; in another case, the tumor is large, prominent, of a deep blue or reddish-brown color, having a large broad base, or being attached by a narrower peduncle, and does not bleed. In these cases the vessels appear to be largely dilated, the mucous membrane covering them being shining and tense, or thick, granular, and slightly ulcerated. Besides these appearances, portions of the mucous membrane, highly vascular and thickened, may be prolapsed at one or more points, as a consequence of the mechanical weight of the internal tumors. In by far the majority of cases of long-standing piles, the integument surrounding the anus is in an unhealthy condition, being much thickened and now and then forming a distinct ring or long pendulous flaps.

There is one point of importance connected with the seat of internal hemorrhoids which should not be overlooked, but which, as far as I am aware, has not been mentioned by any writer on this subject. The circumstance I refer to is this, that occasionally instances are met with where the hemorrhoidal tumors are placed, as it were, in separate rows, so that two or three distinct masses exist near the anus; and about half an inch or more above, other tumors of a similar nature are disposed just in the same way. There are one or two specimens indicating this in the Museum of the Royal College of Surgeons. This is a condition of practical importance; for it shows how necessary it is to make a most thorough examination of a person suffering from internal piles. Cases every now and then occur where the ligature has been applied to one or more internal tumors presenting themselves at the anus; and as the operator is thinking his proceedings are satisfactorily terminated, the patient makes some violent straining effort, and another tumor, or series of tumors, which have escaped notice hitherto, are forced into view. These are formed higher up in the bowel, and do not generally protrude; but if a satisfactory cure is expected, they must not be left alone.

[Curling denies this arrangement in rows, thinking it due merely to the mode of preparation of this specimen for inspection. For the thorough examination of internal hemorrhoids, a speculum is usually necessary, and the best form is the bivalve, shown in fig. 397. It is introduced closed, and then opened widely, so as to expose to view the opposite wall of the bowel; it may then be closed again, turned, and opened, so as to examine successively every portion of the surface. The patient may be either in the standing posture, bending over a chair or the edge of a bed or table, or placed upon the side.]

As regards the structure of internal hemorrhoids,—when first forming, they are composed in many instances simply of dilated veins, in others of dilated veins and arteries too. As the diseased condition increases, the cellular tissue in connection with the vessels becomes thickened and infiltrated. In a more or less circumscribed space, the mucous membrane also becomes thickened, and is bulged out by the increase in size of the vessels, and thus distinct tumors are formed. The surface of the mucous membrane becomes also exceedingly vascular. On making a section of the lower part of the rectum in some cases of old-standing piles, the veins will be found to be greatly dilated, sometimes partially and irregularly, so that there will be the appearance of distinct cysts; in other instances, the dilated vessels will be found to be filled with coagulated blood and fibrin. In those cases where the hemorrhoids are of a very bright red color and sessile, not unlike a strawberry in appearance, and easily bleeding, the structure consists mainly of a series of small arterial ramifications; but where the tumors are of a darker color, and like a mulberry, they are composed of veins to a large extent, although no doubt the arteries enter as well into their formation; for when the mucous covering is pricked or incised, the blood which flows is of an arterial hue. In those cases of long standing, where the tumor has become very large, and has been submitted to great irritation, a section will reveal scarcely anything beyond a mass of highly-condensed and thickened cellular tissue, with some vessels penetrating the base of the tumor.

The *treatment* of internal hemorrhoids requires more consideration than that which is adopted for the disease when situated externally. In the cases where the piles have not existed long, are not large, and give only temporary annoyance, much may be done by the patient paying simple attention to his habits, and avoiding those exciting causes which engender the disease. If it is ascertained that a sedentary life has produced the affection, by determining the blood to the rectum, the patient should take as much walking exercise as possible; if the bowels are sluggish, their action should be encouraged by the compound rhubarb pill, or by a teaspoonful of the confection of senna; and a quarter or half a pint of cold water, or of infusion of quassia, should be thrown up the rectum daily. Dietetic rules must be strictly attended to; for many patients, especially those who are robust and whose circulation is sluggish, will tell us that they feel much more annoyance from piles after they have been dining-out, or have taken larger quantities of wine than usual. Hence the necessity for those who suffer from internal hemorrhoids to abstain as much as possible from the pleasures of the table. Women in an advanced state of pregnancy, suffering from the irritation of piles, should be very careful about the condition of their bowels, and should keep the horizontal posture as much as possible.

When internal hemorrhoids increase to such an extent as to protrude at the closet, and produce considerable pain and bleeding, greater precautions and more decided treatment are needful. The bowels should never be allowed to become costive so as to necessitate straining efforts; the protruded parts should be carefully sponged with cold water, or with a strong infusion of quassia, or of decoction of oak-bark and alum, in the proportion of half a drachm of the salt to twelve ounces of the decoction, and should be carefully returned by the patient; or, instead of these lotions, the gall-ointment may be smeared over the piles with great benefit. The bleeding, which is often very annoying, may be checked by an injection of sulphate of iron and water, in the proportion of one or two grains of the former to an ounce of the latter; or, if necessary, a lotion of tannin, in the proportion of eight grains to an ounce, may be used [or water as hot as it can be comfortably borne]; but it must be borne in mind that a moderate amount of bleeding in persons who live high, and whose vascular system is excited, is beneficial rather than otherwise, and should not be interfered with; the popular notion as to bleeding from piles being salutary is by no means incorrect, when applied to certain cases. When, however, the hemorrhage arises from some peculiar pathological change in the tumor, such as ulceration or excessive vascularity of the mucous membrane, and when it becomes continuous, and goes on to such an extent as to interfere with the patient's health, producing a pallid face, a weak pulse, and irritable heart, it should be put a stop to.

A very common internal remedy for piles is the confection of black pepper, in the dose of a drachm twice a day; it may be given by itself, or, as I often use it, mixed with an equal part of confection of senna. It is difficult to say how the remedy acts; it certainly does good not only in this affection, but in other affections of the rectum, and especially in those cases where the wounds become sluggish in healing after the operations for fistula, or for fissure of the anus.

From the close connection between the neck of the bladder and the rectum, it follows that the affections of the former viscus, together with those of the prostate gland or urethra, will influence the rectum much; and thus in middle-aged or elderly

persons, special inquiry should be directed to these parts; for not unfrequently hemorrhoids and prolapse of the rectum will be found to be much aggravated, if not caused, by the violent straining efforts made in the difficult attempts to pass water. If stricture exists, the urethra must be dilated before there can be any hope of curing the piles; and even if there be not any stricture, and yet there be a loss of the contractile power of the bladder from debility or old age, this viscus should be artificially emptied by the catheter.

When internal piles become inflamed and protruded beyond the sphincter, the patient will suffer much both locally and constitutionally. He must be confined to bed, and the piles, if possible, should be carefully returned by the surgeon; but if this be a work of great difficulty from swelling and congestion, leeches should be applied, and subsequently warm fomentations and poultices. Ice locally applied in a bladder is a valuable agent to diminish inflammation and pain. Opium should also be given in full doses. An operation which may be considered advisable should not be put in force whilst the hemorrhoids are in a state of active inflammation. Sometimes, as I have before stated, the constriction of the sphincter produces sloughing, and a spontaneous cure takes place; if this is occurring, the process must be expedited by the liberal use of warm bathing and poulticing, and pain must be conquered by the administration of opium.

By the adoption and right application of these remedial measures, a large proportion of cases of internal hemorrhoids may be cured, or relieved to so great a degree as to prevent annoyance; but many of the cases which come under the notice of the surgeon have existed so long, the tumors have reached such a size, and are productive of such troublesome and even serious symptoms, that some active surgical interference is required, in order to bring about a cure or render efficient relief. Originally the usual remedy in aggravated cases was the excision of the diseased part, and it was a remedy accompanied with little pain or difficulty; but the danger of hemorrhage proved to be so great, that after the sacrifice of several lives the practice was abandoned. It is necessary, even when the excision of external piles is being performed, to take care that the mucous membrane is not too freely clipped, otherwise dangerous bleeding may result. I saw a gentleman nearly lose his life from the inclusion of a portion of mucous membrane in the blades of the scissors during an operation for external hemorrhoids: the operation was done at 2 P. M.; and at 6 I was sent for, and found that he had been bleeding profusely.

Until within the last few years the radical cure of internal hemorrhoids was effected by strangulating the tumor or tumors by means of one or more ligatures so tightly applied that in the course of a period extending from five to ten days the tumors sloughed, and together with the ligatures separated from the bowel. Indeed even now amongst the senior members of the profession this operation is practised, and there cannot be a doubt that, in the absence of a less severe method of treatment, that by the ligature was the best that could be desired, for it was unaccompanied with the dangers which attended upon the operation of removing internal hemorrhoids with the knife or scissors, and was much more efficacious than the plan of treatment by strong nitric acid. [Van Buren (Dis. of Rectum, etc., p. 40), expresses the opinion still held by many American surgeons, that the ligature is "the safest, surest, and most manageable procedure" for the radical cure of internal hemorrhoids.]

The operation is performed in the following manner. The patient, who has previously had an enema of warm water, so as thoroughly to bring down the hemorrhoidal tumors, either kneels on an arm-chair, or lies on his side upon a bed or sofa. An assistant separates the buttocks, whereupon the surgeon lays hold, with a long pair of forceps or vulsellum, of the tumor which is to be operated on. The assistant makes traction with the instrument, so as to expose and isolate the tumor as much as possible. The operator then, by means of a well-curved needle set in a strong handle, passes a double thread of strong silk or twine through the base of the mass; and having cut the thread and removed the needle, ties each half of the tumor as tightly as possible. The ends of the ligatures are cut off close to the knot, the protruded parts are returned within the bowel, and the operation is finished. It is better to notch the circumference of the tumor at the point where the ligature will fall, before it is tied, as the separation will take place earlier: for this hint I am indebted to Mr. Curling. If there are two or three distinct hemorrhoidal tumors, each of them must be operated upon in the manner I have described.

[The practice of some surgeons is to over-distend the sphincter ani previously to the operation, by inserting both thumbs through it, and forcibly separating them. This not only gives free access to the tumors, but prevents after-trouble, by paralyzing the muscle for a few days.]

If there is much loose integument about the anus, the redundancy should be removed with the scissors. Too much ought not to be taken away, as inconvenient contraction might take place; but the surgeon who understands his business will not be likely to fall into an error of this kind. If the loose flaps of thickened integument which are so frequently seen in connection with hemorrhoids are not taken away by the scissors, there is a probability that the cure will not be perfect. Several cases have lately been under my care where the ligature had been applied by various surgeons, and where the disease had returned. In some of these cases the external folds of integument had not been removed, and I cannot help believing that this neglect had been the cause of the failure of the operations.

The proceedings above detailed are finished in a few minutes. If the patient is courageous and determined, I would rather operate without giving him chloroform; but if he is highly sensitive and timid, it would be better that he should inhale it [or ether], as the pain in such instances may be very severe.

The patient must keep his bed for some days after the operation. A full dose of opium should be given the first night, so that pain may be prevented and the bowels be confined; if there be much pain about the seat of operation, ice applied in a bladder continuously will give great relief. [To some patients, hot water, applied by means of folded flannels or sponges, well wrung out, gives much more comfort.] Retention of urine is apt to follow this operation, and when present must be relieved by the catheter. [It may often be overcome by the application of a folded flannel, or a large sponge, well wrung out of hot water, over the region of the bladder. But the forcible dilatation of the sphincter previous to the operation will generally prevent any such trouble.] It is desirable to keep the bowels quiet for three or four days, if possible, and then to obtain an evacuation by a dose of castor-oil. Very likely the ligatures will separate on the first action of the bowels; at all events they generally come away on the fifth or sixth day. Some pain is felt in the part for a few days afterwards, and during this time the patient should keep quiet: convalescence may be expected in a fortnight from the time of the operation.

This is the general course of things when the operation is successful and unattended with any evil results of any kind; but it is well known that the use of the ligature is occasionally followed by very serious results: and, indeed, several instances has been made public where death has ensued after this operation, the cause of death being effusion on the brain, tetanus, and pyæmia, the latter disorder most frequently. Several fatal cases have occurred in the practice of my own personal friends, and I have had the misfortune to lose two patients after the use of the ligature. One of these patients was a gentleman in the prime of life and very fair health, who died with well-marked symptoms of pyæmia; and in the other case the fatal event was due to the loss of blood during and after the operation.

But besides the risk of death from some of these causes after this operation, it is known that other serious results occasionally follow and give much trouble.

Thus I met with a case of a lady who had lost much blood prior to the operation. I had to employ several ligatures, so that the operation was of necessity severe and prolonged, and it was followed by the most intense pain, so that, notwithstanding the employment of large doses of opium, frequently repeated, I was fearful that she would actually die from the effects of the severe pain she experienced, and which did not lessen until the ligatures separated, at the end of a week. After the subsidence of this, other symptoms manifested themselves, and caused great alarm, culminating, in fact, in a severe attack of phlegmasia dolens of the left leg and thigh, so that she was not enabled to leave the house to go out for a drive until a period of six weeks had elapsed.

In another instance which occurred to me not long after this, I employed ligatures for removing a mass of hemorrhoidal tumors. The patient was a healthy middle-aged man, of temperate habits, living in the country; the operation was followed by most intense suffering, and subsequently by alarming symptoms, very similar to those familiar to the surgeon under the name of traumatic delirium. These continued for some weeks, and at one time threatened to destroy the life of the patient; as it was, he was brought into such a low state that he was unable to leave his house until a period of two months had elapsed from the time of the operation.

A circumstance which occasionally obtains after the use of the ligature, and which causes great annoyance, is the existence of long-continuing and painful ulceration at the seat of one or more of the ligatures, for a period varying from weeks to months. Every one who has had much to do with this operation, must have met with such cases. These ulcerations are most difficult to heal, and give great annoyance both to patients and surgeons.

To sum up briefly then, it may be stated with truth that there are the following objections to the use of the ligature:—The supervention of more or less pain; a tedious

convalescence; occasionally death from pyæmia, tetanus, or general constitutional disturbances, and long-continued and painful ulceration at the seat of ligature.

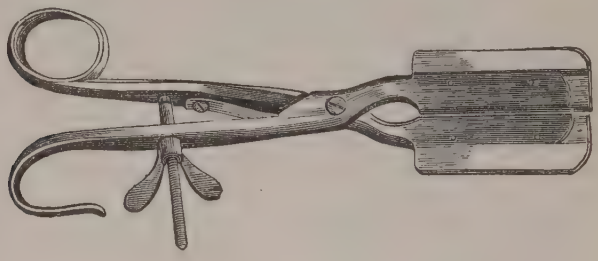
[If the hemorrhoidal tumors are wholly internal, there is not apt to be much subsequent pain, nor, if they are partly external, if care be taken to *completely* divide the skin with the knife before the ligature is applied. Tetanus is usually the result of exposure to draughts of air, by neglect on the part of the patient or his attendants; I have seen three cases in one year, after this operation, clearly to be thus charged. The other ill-effects mentioned are equally likely to follow any operation about the anus.]

It is the duty of the surgeon to adopt some other means if he has them in his power, by which these results may be obviated, and by which the disease can be cured; and fortunately he is enabled to effect this by employing a mode of operation which is now being pretty extensively used, and which is well known under the name of the operation by the clamp and cautery, and which I will now proceed to speak of; but before describing that modification of the operation which was introduced to the profession by myself, I must briefly refer to the history of this mode of treatment, which probably will almost entirely supersede the employment of the ligature.

As far as I am aware, this plan of treating hemorrhoidal tumors was originally practised by the late Mr. Cusack, of Dublin, about thirty years since; but its introduction to London surgery is, I believe, due to Mr. Henry Lee, who so long since as 1848 described a pair of forceps or clamp, which he appears to have used extensively; for in his volume of Pathological and Surgical Essays, published in 1854, he has narrated many cases where he employed it, and applied either nitric acid or the actual cautery for the purpose of arresting the hemorrhage after excising the tumors. In addition to the clamp originally used by Mr. Lee, and which was somewhat cumbersome, there was another kind of instrument, shaped somewhat like a pair of scissors, and which was much more suited for the purpose.

In the year 1863 I first began to treat cases of internal hemorrhoids and prolapsus by the clamp, employing, after excision, the strongest nitric acid for the purpose of obviating bleeding. I soon became convinced of the value of this mode of treating these disorders, but in a short time I found out that very great improvements in the construction of the clamp were called for, and, with the assistance of the late Mr. Matthews, of Portugal Street, I introduced to the notice of the profession the instrument which bears my name, and which is now generally used. It is shaped somewhat like the ordinary clamp used by Mr. Curling

Fig. 399.



for the purpose of seizing and applying nitric acid to hemorrhoidal tumors; but the blades are so constructed that they meet accurately at their edges, and are closely fitted into one another by means of a raised surface on one and a groove on the other edge. In this way, and if the blades are made perfectly parallel, the most perfect and accurate compression is made upon a tumor or portion of mucous membrane. A more important feature, however, in the mechanism of this instrument, is the adaptation of a light yet powerful screw to the shank of the instrument, just above the handles. The object of this is twofold—in the first place to compress the blades, and in the next to take off the compression after the actual cautery has been applied; and by the slightest turn of the screw, this may be effected so gradually, and yet so thoroughly, that should any vessel be left uncauterized, its situation can be at once seen by the issue or jet of blood, and the cautery can be reapplied.

The latest, and a very important addition to the instrument, consists in the adaptation of a layer of ivory to the outer surfaces and external edges of the clamp, so that the heat from the cautery cannot be transmitted to the surrounding parts, and thus much suffering is prevented.

I will now proceed to describe the mode of application of this instrument, and this description will apply both to cases of hemorrhoids and prolapsus of the rectum.

In the first place, the part to be operated upon is made to descend either by means of an enema or by the patient sitting over hot water: the tumor is then seized by a pair of hooked forceps, and firmly held by an assistant. The clamp is now carefully applied to the base of the tumor, and the blades are closed by means of the screw. After having seen that this is done effectually, the surgeon takes a sharp pair of scissors and cuts off the whole of the tumor; the cut surface is wiped, and carefully and repeatedly touched by the heated iron until it is considered that the entire surface is thoroughly cauterized.

The screw is now gently turned, the grasp of the clamp is thereby somewhat relaxed, and if any vessel has not been sealed up it will emit blood, and the cautery can be again applied. Sometimes this process may be needful two or three times before the bleeding is quite stopped. As soon as it is ascertained that the surface has been thoroughly cauterized, the clamp is removed, and if more than one tumor exists, each of them is successively dealt with in a similar manner. The finger, oiled, is then introduced as far up as possible into the bowel, so as to push the parts well up and cause the sphincter to contract; a suppositorium of two grains of extract of opium is introduced, and the operation is completed. If only one tumor requires removal, the proceeding may be finished in a minute or two; but if there are several tumors, the operation cannot be safely or satisfactorily concluded under ten or fifteen minutes.

There are one or two points connected with the operation which demand attention. In the first place, the facility of the whole business depends greatly upon the extent to which the parts are exposed. If the tumors are well brought down outside the anus, the clamp may be applied very readily; but when the tumors are not thoroughly protruded, or are very small, it is very difficult to apply the clamp. In some instances, where the skin of the anus and the mucous covering of the hæmorrhoids run into each other, I apply the scissors at the point of junction before applying the clamp. It is well not to cut the tumor too close to the upper surface of the clamp, but to leave about the eighth of an inch of the tissue, which can thus be more readily acted upon by the cautery. On no account should an endeavor be made to embrace more than one of the tumors within the blades of the clamp at the same time. I generally apply the cautery either at a black or dull red heat; if it is too vivid, the agency is more destructive than is needful. We should err rather on the side of a too liberal application of the hot iron than otherwise.

[Mr. Henry Smith (the author of this essay) has recently published an account of instruments used by him, in the shape of cutting and serrated cautery irons, in operations for hemorrhoids, as well as for other purposes, such as severing the pedicle in ovariotomy, etc. (Lancet, March 5, 1881).]

With regard to the employment of chloroform, I am guided by the following considerations: If the patient resolutely demands it, of course he must use it; if at the same time that the operation on the internal piles or prolapsus is being done, any extensive removal of skin be required, I recommend chloroform; or if the patient objects to that, I use the anæsthetic ether, which, when thoroughly applied, answers very well in mitigating, if it do not altogether prevent pain.

[Ether, properly given, is quite as effective an anæsthetic as chloroform; a fact which is now known to many surgeons in England, and has long been generally recognized in this country.]

For the purpose of locking up the bowels, the same precautions as are needful in other operations on the rectum are taken. At the end of the third or fourth day a dose of castor-oil is given, and the bowels are generally easily moved; a little blood which has collected in the bowel either during or after the operation may come away. If the patient has not been much weakened by long-continued hemorrhages, he or she may be allowed to get up; and in by far the majority of cases they do so; but if the health has been much shaken, or the operation has been extensive and has involved the removal of much skin, it will be advisable to keep the patient in bed or on the sofa until the bowels have been acted upon a second time, two days afterwards, when it will be found that the patient is able to move about or attend to his ordinary business.

I have now performed this operation in upwards of 200 cases, and I can with truth state that, if it be properly done, there is hardly an element of danger in it. I have operated at all ages, from puberty up to nearly eighty, and in instances of the utmost severity, in cases where the tumors have been immense, and when the patients have been so thoroughly blanched by long-continued bleeding, that one would not dare to perform any operation, unless convinced of its absolute safety. I have not met with a single instance where secondary hemorrhage has followed either the operation for hemor-

rhoids or prolapsus. And with the exception of one instance where the patient had organic disease of the liver, and where a very large artery was divided, I have not been obliged to resort to the use of the ligature of any vessels after the application of the cautery. I have not met with any undue contraction in the gut afterwards. In one instance only, some contraction of the anus took place, but I had removed freely some external skin: here, however, the use of a bougie for some time soon relieved the contraction.

In two instances death followed the operation, but a reference to the details will show at once that the fatal event in each was a post hoc, but not propter hoc—

In the one instance the patient was a lady, ætat. sixty, and had suffered dreadfully from hemorrhage for many years, and had become so reduced in health that for some time before I saw her she could not take any solid food, and in this state the prolapsus came down, and could be with difficulty returned. I was summoned into the country to see her, and although she was in such a feeble state, I, in conjunction with her medical attendant, thought it best to relieve her of this annoying cause of irritation. I operated with the clamp and cautery on January 26, 1868. The operation was easy, unattended with loss of blood. On the fourth day the bowels acted freely without pain, and so far as the actual operation went, it was, to use the words of her medical attendant, "very successful;" but she never rallied from the weakness she had been suffering, and died from exhaustion on the thirteenth day.

In the second case, a lady between fifty and sixty was operated on by me in October, 1868. She also had been suffering for years under the most profuse bleeding from internal piles, and when I was consulted she was in a most wretched state from bloodlessness. The operation was performed without any loss of blood, and she was able to get on to the sofa on the sixth day. On this day a favorite daughter suddenly came to see her; she was thrown into the most violent state of hysteria, which lapsed into mania, and then into coma, in which she died on the thirteenth day, without any symptom of any local mischief about the wound, which was nearly healed. It was subsequently ascertained that a favorite son of this lady had suddenly died not long since, and that then she had a violent attack of the same symptoms. It is most probable that some latent disease of the brain existed, and that the sudden mental excitement in her feeble state had lighted it up again.

This operation is, I believe, particularly adapted for those cases of severe hemorrhoids or prolapsus where, either from age or from the presence of some other concomitant disease, the operation by the ligature would of necessity be attended with danger. Thus in two instances of severe hemorrhoids, attended by symptoms of paralysis, where the local disease produced much annoyance, I did not hesitate to use the clamp, although in each case the patients were advanced in life; and the operations were attended with as little disturbance as in perfectly healthy individuals.

In only one instance have I refused to employ the clamp, and this was in the case of an aged gentleman, to whom I was called by Mr. Cross, of Petersfield, and who had a very large prolapsus. The patient was otherwise seriously ill with general debility, and some indications of cerebral mischief; and although the local disorder had evidently aggravated his condition very much, I quite agreed with Mr. Cross that it would not be wise to operate even with the clamp, and the wisdom of our determination was shown in a few days by the gradual sinking and death of the patient.

The advantages which I claim for this proceeding, which I now always adopt in cases of hemorrhoids or prolapsus, are, that there is considerably less risk to life than when the ligature is used; that in the majority of cases the suffering both attending and following the operation is much less, and that the period of convalescence is rendered much shorter. It is true that the operation itself is complicated and somewhat tedious, as compared with that by the ligature, but these considerations ought not to weigh with the surgeon when the advantages of any particular proceeding are great and palpable.

Nitric acid was strongly recommended by the late Dr. Houston, of Dublin, as a means of getting rid of some forms of internal hemorrhoids; and it was somewhat curious that, although his paper was published in the Dublin Quarterly Journal more than fifteen years since, and Sir W. Fergusson, in his Practical Surgery, soon afterwards drew especial attention to the subject, the use of the agent is still comparatively unknown, or at all events has not had that attention paid to it which it deserves. I have been in the habit of using the strong nitric acid in certain cases of hemorrhoidal affections for many years. Mr. Henry Lee has incorporated with his Surgical and Pathological Essays an admirable paper on this subject, and has spoken highly of the plan of treatment which I am now about to consider.

I have stated, whilst describing the nature of internal hemorrhoidal diseases, that the condition in which they are found varies. I have endeavored to point out those cases to which an operation is applicable, and have stated that this practice is justifiable in those instances where the tumors are large, mainly com-

posed of tissue in which the veins predominate, and have become indurated.

There are, however, other instances where the hemorrhoidal tumors are small or moderate in size, and where they are evidently composed of morbid texture in which the small arteries rather than the veins are interested, as shown by their bright florid aspect, and by their tendency to pour out arterial blood whenever the patient is at the closet, or when the tumors are handled. These tumors are sessile, and generally not very prominent. They produce exceeding annoyance, and indeed prove most destructive to the health, as they generally yield a great deal of blood. Now, in such cases, an operation will undoubtedly be as effective as in the other instances before described; but this proceeding is not necessary, as the local use of the nitric acid is so eminently suited to them. The relief which one single application of the acid gives in these cases is remarkable: and an excellent cure may be effected if the whole of the diseased texture be subjected to its action.

About this particular kind of case there is no doubt in the mind of any surgeon who has seen the nitric acid applied in a proper manner. There is, however, a mixed class of cases where the remedy is an uncertain one, but in which nevertheless the surgeon is justified in trying it, and where I sometimes have succeeded when I little expected it. I refer to those cases where there is a hemorrhoidal mass, consisting perhaps of one tumor mainly composed of venous ramifications and of a bluish color, with one or more presenting the characters of the florid sessile pile; or one portion of the tumor or tumors may present the dark blue appearance and thickened membrane, and another portion of it may be brightly vascular, and have its mucous covering granular or slightly ulcerated. In this kind of mixed case I do not hesitate to try the acid, if the patient is particularly desirous; but I make a point of stating that it is impossible to depend upon any curative action in such a case, although in some instances the remedy has acted most efficiently.

To apply the agent in those cases where the tumors are large and indurated, and have a deep blue color, would be perfectly useless, and only bring discredit upon the nitric acid as a means of cure in other kinds of hemorrhoidal diseases.

It is, however, in that class of cases not unfrequently met with, where there is not so much any decided hemorrhoidal tumor, but where there is a congested and relaxed condition of the mucous membrane of the rectum, attended with bleeding to a greater or less extent, that the nitric acid acts so beneficially. Dr. Houston has compared this condition of the rectum not inaptly to that of the thickened conjunctiva after long-continued ophthalmia. The application of the acid to the diseased points from which the bleeding proceeds will soon remedy all the bad symptoms.

The following is the mode of applying nitric acid:—The bowels having been well evacuated some hours previously, the diseased portion to which the application is going to be made should be well exposed by making the patient sit over hot water for some few minutes; or if this is not sufficient, an enema of water should be thrown up the rectum, and the hemorrhoidal disease will be brought into view. The part to which the acid is to be applied should then be carefully wiped with a piece of lint. The surgeon then dips the extremity of a small flat piece of wood into the nitric acid, and touches the diseased surface carefully with it. The part touched, and the neighboring mucous membrane, is well smeared with oil, and the whole is returned within the orifice.

I can truly say that it has never occurred to me to witness anything like a fatal, or even a dangerous result, after having had a large experience of this remedy. In one case, of a patient who was most anxious to be cured by one operation, I applied the nitric acid much more freely than usual, and produced great suffering for two or three days, with the effect, however, of making a good cure. In another instance, I heard, but was not a witness of the fact, that copious bleeding followed the use of the acid. In a third instance, which occurred very lately, a young lady was treated with the nitric acid for a florid pile. Severe and unaccountable suffering was produced for many days. On making a careful examination at the end of this period I discovered a small ulcer situated at the posterior verge of the anus, and exquisitely painful; suitable remedies relieved the pain in a few hours. On inquiring more minutely into the particulars of this case, I have reasons for believing that this ulcer existed before I applied the acid, and that some of the caustic came into contact with the sore and produced the severe suffering.

I have now and then met with cases when retention of urine and some bleeding have occurred after the free use of the nitric acid, but never sufficient to cause me anxiety; and they are symptoms which are easily met.

It is not necessary to confine patients to their bed after the acid has been applied; and this is one of the reasons why the remedy is so desirable, many patients

having neither the time nor inclination to submit to an operation which may keep them from their business or pleasures for a fortnight or more.

Within the last few years some French surgeons, and especially M. Chassaignac, have strongly recommended the employment of the écraseur for the removal of internal hemorrhoids. The practice has also to some extent been followed by surgeons in this country. The object sought by the use of this instrument is the more or less rapid removal of the tumors without hemorrhage. That this can be effected in a great number of instances there is not a doubt; and if no evil result were likely to follow, this practice would in all probability be adopted in many of those cases where an operation was required, notwithstanding that there is a great deal of pain attendant upon the process. One very serious consequence, however, of this plan of treatment has been met with in several instances in Paris: this is the occurrence of stricture of the rectum some time after the wound has become cicatrized. This very grave objection to the employment of the écraseur is sufficient to counterbalance its real or supposed advantages; and although it would not be wise entirely to discard its use, the necessity for it must be rare, and in those few instances where it would be required, the surgeon would do well to take every precaution to avoid the occurrence of contraction of the gut.

[A rather large experience in the use of the écraseur in the treatment of hemorrhoids warrants me, I think, in endorsing the favorable opinion of it entertained by the French surgeons. It is very effectual, and if the operation is done slowly, there is no danger of bleeding. The wound left heals very readily, and unless the instrument is recklessly applied, undue contraction of the parts need not be feared. Pain has never been complained of by any of my patients after its use.

Mr. George Pollock has lately (Lancet, July 3, 1880) advocated the crushing of piles by means of an instrument devised by him, much like Nott's *rectilinear écraseur*.

So far as my knowledge goes, American surgeons find in the ligature and the écraseur the best means of dealing with tumors of this kind which require operative interference.

Another plan relied upon by a few surgeons is the mere forcible distension of the sphincter, done in the way already described. I only mention it to condemn it, as an uncertain remedy.

Still another, the injection into the tumors of a few drops of strong carbolic acid, has been extensively used in this country, and especially in the Western States; but it has not found many advocates in the ranks of the regular profession.]

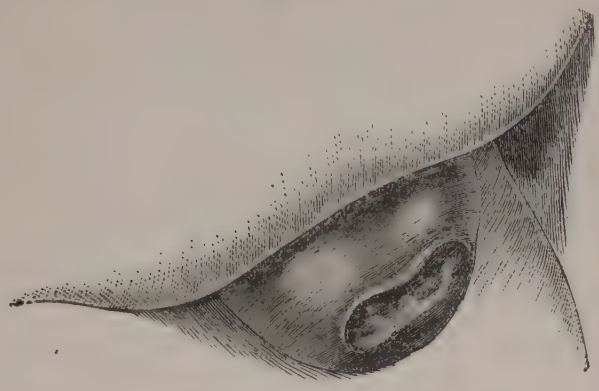
Prolapse of the Rectum.

During the time that the rectum is evacuating its contents in a natural and normal manner, more or less extrusion of the bowel occurs; but this is only momentary, for as soon as the action is finished, the mucous membrane is immediately withdrawn within the anal orifice, and no inconvenience results. When, however, from some particular cause, there is any impediment to its return, those changes which ultimately lead to the disease we are considering occur; the mucous membrane becomes congested and swollen; its attachment to the muscular tissue, naturally loose, becomes weakened; and in course of time the protrusion of the membrane becomes habitual, constituting one form of prolapse of the rectum, and that the most frequent. In other cases, however, there is a protrusion not only of the mucous and submucous tissues, but of the whole of the thickness of the lower part of the bowel as well. A preparation in the Museum of King's College puts an end to all doubt on this point. This kind of prolapsus occurs not unfrequently in children, and is of great extent, the protruded bowel being sometimes five or six inches in length. In very old people this complete prolapsus of the rectum occurs, reaching to an immense size. On examining a recent case of prolapsus of the rectum, where the least amount of change has taken place in the structure of the parts, as for instance in a child, the protruded part is found to form a tumor of an oblong shape and cylindrical form, presenting externally the smooth vascular surface of the mucous membrane, which is generally of a more or less bright red color, and covered with mucus; at the extremity of the tumor is the orifice or cavity of the bowel, and at the anus there is no deep furrow between it and the protruded part, as there is in the intussusception of the rectum. Even in the adult, when the prolapse is large and of recent occurrence, the mucous membrane may be as unchanged in appearance and texture as when it occurs in the child, but the tumor has more of a globular form.

The most frequent condition in which a prolapsus of the rectum is seen is where there are one or two lateral folds of the membrane, varying from one to two inches in length, protruded from the anus, or one unbroken ring of protruded membrane is seen—but this is more rare.

If the disease has not long existed, the membrane is not much changed in appearance, being only somewhat thickened and more vascular than natural; but should the bowel have been habitually prolapsed for some years, considerable changes take place, and on examining an old case the following will be the appearances. Externally there will be a ring of thickened integument; within this the flaps of mucous membrane hang down, their lower portions being much thick-

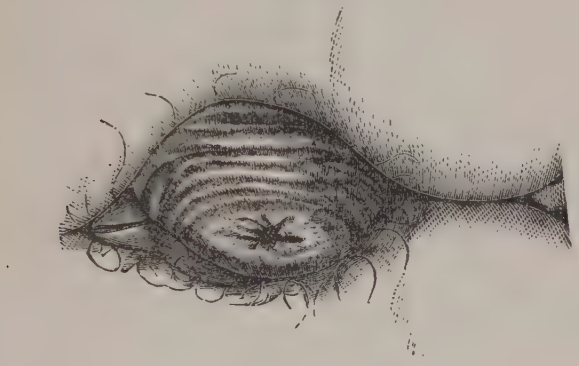
Fig. 400.



Prolapsus in child.

ened, having lost the peculiar character of mucous membrane, and being assimilated to integument; this change has taken place because the most dependent portion is that which either habitually remains protruded altogether, or is protruded for a longer time, and more exposed. On separating the flaps of the prolapsus, the upper part of the membrane is found either but little altered from its natural character, being red, smooth and vascular, or superficial ulcer-

Fig. 401.



Prolapsus in adult.

ation may have taken place where the two portions have been in contact. There is more or less mucous discharge produced, but in pure prolapsus there is little hemorrhage.

Sometimes, in persons advanced in life, the protruded part consists of a tumor as big as the fist, which has habitually protruded for a long time. In such a case, a very large proportion of the tumor consists of membrane more like leather than the natural tissue. In these old-standing cases the sphincter becomes extremely relaxed, and the anus very capacious; there is generally a redundancy of loose and thickened skin around; sometimes it hangs down in long pendulous flaps—this state of the parts adds materially to the facility of the occurrence of the prolapsus.

In many cases the prolapsus of the rectum is complicated with distinct hemorrhoidal tumors, which in fact are mainly, if not entirely, the originators of the affection; for when one or more internal tumors exist, they themselves, each time

the bowels act, become protruded, and drag portions of the mucous membrane down with them; so that not unfrequently a patient presents himself with one or more folds of prolapsed membrane, and at the same time with distinct hemorrhoidal tumors.

The inconvenience and suffering which prolapsus causes is considerable, for although at the onset of the affection the protruded part may pretty readily return within the sphincter after an evacuation, as time wears on it becomes necessary for the patient himself to return the part, which not rarely is a task of difficulty, and attended with pain; moreover, from the contiguity of the rectum to the neck of the bladder and urethra, there is often great distress of these parts,—constant irritability, and even retention of urine, being an accompaniment of the affection; pain and uneasiness are felt in the loins and down the thighs: the intestinal canal and stomach also sympathize, the patient being troubled with flatulence, loss of appetite, and low spirits.

If the prolapsus cannot be returned by the patient, most violent symptoms occur —extreme pain in the part, and retention of urine; and if unsuccessful attempts are made to reduce the swelling, which is in all probability tightly constricted by the sphincter, violent inflammation of the part attended with severe constitutional suffering occurs; and in some instances sloughing of the protruded bowel takes place, by which means a cure is brought about, but the mischief may be such as to cause death. In cases where a prolapsus occurs in children to a great extent, and has been allowed to remain down for two or three days, the local and constitutional changes are not so severe; the prolapsed membrane, however, becomes exceedingly congested.

The causes of prolapsus are constitutional and local; thus the disease is very frequently met with in individuals who have suffered from general debility and laxity of fibre. In children especially, the affection is met with in instances where the health has been reduced by insufficient nutriment, bad air, and want of proper attention. An adult or old person who suffers much from prolapsus, usually has a weak pulse, a flabby tongue, and impaired digestion; and in the child there is an unhealthy and dry skin, a foul tongue, and a tumid belly. The local causes which produce falling of the bowel in children are, stone in the bladder, and ascarides. In adults, constipation, sedentary occupation, the straining caused by stricture of the urethra, and enlargement of the prostate, are fertile causes of the disease. There is no doubt, moreover, that the pernicious plan of frequently using copious enemata is very constantly productive of the disorder.

In considering the treatment of prolapsus of the rectum, we shall first refer to that which is necessary in removing the affection as it is met with in young children. In the first place, it is necessary to seek for its cause; and especial inquiry should be made with reference to the urinary apparatus, for it not unfrequently happens that it is the irritation of a calculus in the bladder which produces the extrusion of the gut; and if this be so, it is obvious that the remedy consists in the removal of the stone. If there be not stone in the bladder, a collection of ascarides in the rectum may originate the disease; and the destruction of these parasites by a few doses of scammony and calomel, together with the daily injection of a few ounces of strong infusion of quassia, will prevent the prolapsus.

In by far the larger proportion of cases occurring in children the general health will be found at fault, and this must be attended to before the prolapsus can be got rid of. In the first place, it is necessary to return the protruded bowel; and this is sometimes a work of difficulty, because the child struggles violently and cries. The protruded bowel should be gently but firmly grasped by the right hand, well oiled; careful pressure, so as to empty the vessels, should be employed, until the whole is returned within the sphincter. When the protrusion has been large, however, and the child is very violent, the gut will soon fall again; and in this case the best plan to pursue is to place the child under the influence of chloroform [or ether], and the bowel will be readily returned. A pad and bandage should then be employed in order to secure the part. The secretions of the liver and bowels should be rendered healthy by the use of small doses of rhubarb and hydrarg. c. cretâ; the skin be kept in good order by the warm bath; the child should be carried about in the fresh air; the diet must be nutritious and in small volume; and the strength and appetite are to be increased by small doses of the pulvis cinchonæ and soda. As the health improves, the prolapsus will cease to appear; but should this persist, the part may be bathed with a solution of sulphate of iron, gr. j to ℥j of water; or an injection of tincture of sesquichloride of iron, ℥j to ℥vj of water, may be thrown up every morning after the evacuation of the bowels, and after the protrusion has been returned. In some cases the prolapsus will recur whenever the child evacuates. This accident, however, may be prevented by so managing that the child should be in a kneeling posture during the act.

Another plan which sometimes succeeds in preventing the protrusion, consists in an attendant drawing on one side the skin of the anus with some force, during the time the bowel is being emptied; by this means a certain amount of temporary contraction is produced, which prevents the descent of the gut. In adults, a considerable number of the cases which are not severe, and which have not been of long standing, may be cured by careful attention to the removal of those causes which have produced the disorder. Thus, if it has resulted from violent straining and constipation of the bowels, some mild aperient should be exhibited occasionally, which will prevent accumulation in the bowel, and render the contents more fluid. The compound rhubarb-pill at night will have this effect; or, what is perhaps better, one or two teaspoonfuls of confection of senna should be taken. The patient should not eat largely, and should especially avoid vegetables in any quantity. He should take exercise, and be careful to use plenty of cold water to the parts after the action of the bowels. Occasionally a little cold water, or a few ounces of the decoction of oak bark, may be thrown up the rectum; and if there be the least protrusion left after the evacuation of the bowels, the gut, having first been well sponged, should be carefully returned.

By attention to these various measures a prolapsus of small extent may either be entirely cured, or be prevented from increasing or proving troublesome. And therefore it is of the highest importance to place reliance upon medical treatment in such cases. In by far the majority of cases, however, which are presented to the notice of the surgeon, the prolapsus is either very large, or has existed so long a time that medical treatment would be of no use whatever. And then some strictly surgical means must be adopted, if a cure, or even if palliation of the disease, is looked for. If the case is of only recent occurrence, and yet the prolapsus be very voluminous and incapable of being returned, thereby causing much alarm and suffering, it is the duty of the surgeon at once to reduce the prolapsed bowel. This is best effected by placing the patient on his side, with his knees drawn up, and grasping the tumor either with the naked hand well oiled, or with a cloth intervening. Firm and steady compression should be used, until the whole of the tumor be returned within the sphincter. The patient should then lie quiet for some hours, and afterwards a pad should be applied to the anus, and be secured by a firm bandage across the perineum and around the loins. In order to prevent a return of the prolapsus, the whole or greater portion of the mucous membrane should be smeared over with solid nitrate of silver, previous to its being returned by the surgeon. In one remarkable case of immense size occurring in a young man, I adopted this plan, with the result of obviating the necessity of a bandage, which he had worn continually before.

In order to bring about an effectual cure of the chronic and severe cases of prolapsus, more decided means must be adopted. We have seen that the disease essentially consists in a relaxed and thickened condition of the mucous membrane, and a separation, as it were, of this from the muscular coat. When this is involved also, there ensues a weakness and detachment of the whole of the thickness of the bowel from the surrounding supports. The object to be obtained is to reduce the redundancy or relaxation of the mucous membrane, to promote adhesion between the several tissues composing the bowel, and to brace up the anus and the sphincter. The late Mr. Hey, of Leeds, was the first to propose a proceeding which insured the latter result; and this consisted in removing the loose and pendulous flaps of skin which existed around the margin of the anus, in the case alluded to by him in his Practical Observations on Surgery, p. 443. In some cases, where the sphincter is very relaxed, and the flaps of integument loose and thick, a cure may be brought about by the removal of these alone; but when the prolapsus is very large, and a considerable portion of the mucous membrane has become converted into tissue approaching to integument, it will be necessary to adopt the modification of the operation proposed by Dupuytren, which consists in removing radiating folds not only of the skin at the margin of the anus, but also portions of the diseased mucous membrane. This operation is effected by laying hold of the fold of skin on each side of the anus with forceps, then with a sharp curved pair of scissors removing both skin and mucous membrane. In very severe cases four or six applications of the scissors may be necessary; the operation is painful, but is soon accomplished; as the wounds heal, contraction takes place, the aperture of the anus becomes diminished and braced up, and the prolapsus no longer occurs. [Here the écraseur may be used to great advantage.]

It is important to bear in mind that, in very severe cases, not only is it necessary to remove the relaxed integument, but portions of the mucous membrane, which in instances of long standing has become converted into a tissue more like leather than anything else, must also be taken away: if this step be not resorted to, a disappointment will ensue as regards a complete remedy of the prolapsus. Hence

the surgeon must think of the possibility of somewhat severe hemorrhage, which will occasionally occur. After a portion of the mucous membrane, however small, has been snipped away, I have seen it occur to a very great extent, and when it was least expected.

If hemorrhage to a large extent does occur after a surgical operation on the rectum, the patient will in a few hours complain of tenesmus, and express a desire to go to the closet; he will then evacuate a large quantity of blood, and become faint. In such a case it will be necessary to clear away any coagula which may be in the gut, to elevate the pelvis, and introduce some ice into the bowel. Should this not stop the bleeding, a careful examination should be made with a speculum, and the bleeding orifice be looked for and tied. Sometimes it will be difficult, or almost impossible, to effect this; and then the rectum must be carefully plugged by portions of sponge or lint, to which a thread should be tied, that the compress may be more readily withdrawn when the bleeding has ceased.

It may here be stated, that the risk of severe hemorrhage after the mucous membrane has been excised may be in a great measure obviated by the surgeon taking care to introduce, through the edges of each incision, one or more fine sutures before the patient is left.

Another mode of curing prolapsus consists in the application of the ligature to portions of the prolapsed membrane. This plan is especially adapted to those cases where there is great laxity of the mucous membrane, and where the surrounding integument is not much involved; also to those cases where the prolapsus is associated with one or more hemorrhoidal tumors. This operation was originally proposed for prolapsus by the late Mr. Copeland, who found it to answer his expectations most admirably. It is easily done, by pinching up, with a pair of forceps, small portions of the diseased membrane, applying around each a tight thread, cutting off the extremities, and returning the parts within the sphincter. If there are distinct hemorrhoidal tumors to deal with, the operation as undertaken for them, and described in another place, must be performed. As the prolapsus is in a great measure the result of the hemorrhoids, the cure of the latter will be followed by the disappearance of the former.

In either of the operations just described, however, there is a certain amount of danger, and they compel a close confinement to bed and to the house for a week or two; and therefore, if there is any other agent by which the prolapsus may be remedied, without producing either the danger to life or the confinement to bed, it should be adopted. The *strong nitric acid*, which, locally applied to some forms of hemorrhoids, is found to act so well, has lately been used by me in some severe and long-standing cases of prolapsus with considerable success. It is, however, only in certain forms of the affection that the remedy will act beneficially. In the cases of prolapsus of large size and of very long standing, where the mucous membrane has become very much thickened, and changed in its structure and appearance, the acid will do little or no good; but in those cases of simple prolapsus of the bowel where there are one or more large folds of mucous membrane, and where the tissue is extremely vascular, presenting the appearance of smooth velvet, or is perhaps superficially ulcerated and readily bleeds, the strong nitric acid, applied carefully to the whole or the greater portion of the diseased membrane, will act like a charm. It should be used in the same manner and with the same precautions as when employed in instances of hemorrhoids. If the entire surface of the prolapsed membrane be touched with it, one application alone will suffice to get rid of the disease; but it is better to apply the acid to a part only, and thus two or three operations may be necessary. This remedy, when carefully used, generally causes less pain than when it is applied to hemorrhoids; for the mucous membrane, after having been long prolapsed, generally becomes much less sensitive than it is when in its usual condition.

Cases of prolapsus are occasionally met with in persons of very advanced age, or who are suffering from some internal disorder which would forbid the employment of the ligature. Probably there is, in conjunction with an extensive prolapse of the mucous membrane, a very weakened condition of the sphincter, and an abundance of loose and thickened integument around the anal orifice; consequently the use of nitric acid alone will not suffice to remedy the disorder, even if the mucous membrane be not much altered in its character. In such cases I combine the use of the nitric acid with the removal of two, three, or four slips of the thickened integument from around the margin of the anus. The acid should first be thoroughly applied to the mucous membrane on one or more occasions; and after the lapse of a few days the subsequent part of the treatment should be adopted by using the scissors in the manner before described. Most beneficial results will follow from this practice, and it may be undertaken without fear of danger in cases where the ligature would not be justifiable.

Although either of these methods of treatment may be adopted with success, I now almost invariably remove a prolapsus in the adult by the operation with the clamp and cautery, as in instances of hemorrhoids, and in precisely the same manner. If the tumor be small, it is only necessary to remove one or two folds of mucous membrane; but if, as in some cases, it be very voluminous, it is needful to apply the clamp to several portions of the protruded membrane. If there be great laxity of the anus with redundancy of skin, two or three slips of the latter should be removed with the scissors, as in the operation of Dupuytren. I find this treatment is just as successful as when it is practised for the removal of hemorrhoids.

In those cases where any operative measure is not advisable, great relief may be obtained by the use of a pessary or spring pad.

Fistula in Ano.

The artificial communication between the cavity of the rectum and the neighboring textures, denominated fistula in ano, constitutes an affection of very great interest and importance, as there is a difference of opinion regarding the exact pathology; and for the most part an operation more or less severe is required for the cure of the disease.

Very opposite opinions have been propagated by eminent surgeons regarding the formation of fistula. Thus, it has been confidently asserted by Sir B. Brodie, that the origin of the disease was the existence of an ulcer in the mucous membrane, and that the suppuration in the neighboring textures was subsequent to and dependent upon this ulceration. On the other hand, it has been as confidently stated by Mr. Syme that the first step in the formation of this disease was an inflammation and suppuration in the cellular tissue external to the bowel, and that the abscess subsequently opened into the gut, and thus the fistula was constituted. [The editor has seen one case in a female child eight months old. The parents did not know how long the trouble had existed, but the child, which had been nursed altogether, had shown signs of uneasiness for several months. I could trace no cause for the affection, and am inclined to think it was congenital.]

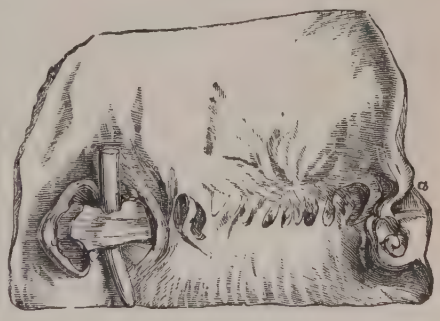
There can be no doubt that the disease originates in both ways. We are acquainted with the fact that inflammation and ulceration of the mucous coat of the rectum occur both spontaneously and as the result of injury produced by foreign bodies; ulceration having occurred, some of the contents of the rectum escape into the surrounding cellular tissue, and excite suppuration.

[The late Dr. W. E. Horner, Professor of Anatomy in the University of Pennsylvania, used to describe an arrangement of pouches opening upward, in the mucous membrane of the rectum, by which the entanglement of seeds, bits of bone, etc., contained in the feces, was favored. His account may be found in his Special Anatomy and Histology, vol. ii., p. 46 (ed. of 1851), where he quotes a paper on fistula in ano, by Ribes, in the Mém. de la Soc. d'Emulation, 1826. He says, also, that Glisson and Ruysch had described them as valves, and that Winslow was acquainted with them. The latter author (Douglas's Transl., 1743, vol. ii., p. 149) says, "they form little bags, or semilunar lacunæ." Another American writer, Bushe (Malformations, Diseases, and Injuries of the Rectum and Anus, 1837, p. 15), speaks of these pouches, and confirms Winslow's description. They are mentioned also in the treatises of Leidy and S. G. Morton. Hyrtl (Handb. der Topogr. Anatomie, 1871, Bd. ii., p. 142) describes them quite fully, and speaks of their agency in the development of fistulæ.

Mr. W. T. Clegg, of Liverpool, says (Lancet, Feb. 5, 1881), that Mr. Bickersteth has for four years been describing these anal pouches, which "are not mentioned in any of the books he has consulted."

It is certainly strange that this arrangement, so clearly pointed out, should have been passed over in silence, not only by many anatomists, but by late writers on rectal surgery; yet it is undoubtedly a frequent cause of fistula. In fig. 402 these pouches are shown, with a fistula, probably formed by a foreign body lodg-

Fig. 402.



Section of rectum, showing the rectal pouches, and a fistula with a bougie passed through it, the mucous membrane dissected off. At *a* is a small external pile, cut in half. St. George's Hospital Museum, ser. ix., No. 42 (Holmes, Princ. and Pract. of Surgery).

ing in one of them. Over the fistula the mucous membrane has been removed, and a bougie has been passed through the canal.]

In the majority of cases of fistula in ano, the first step in the formation of the disease is the existence of an abscess in the cellular tissue surrounding the bowel; as the matter increases, the various textures are involved, the cavity of the bowel is pressed upon, the mucous and muscular coats are separated to a greater or less extent, and at last the former membrane is penetrated.

It has been asserted that the correct appreciation of the true pathology of fistula is of little consequence; but it is almost impossible to mention a surgical disease where it is more needful to know the steps of its formation; for the prevention of the malady, which must ever be looked upon as of more importance than its cure, depends almost entirely upon our knowledge of the fact that in a great number of cases suppuration outside the bowel is the cause, and not the effect, of the disease.

When suppuration has taken place in the areolar tissue around the rectum, and the matter has discharged itself, the cavity of the abscess commonly does not heal, in consequence probably of the periodical disturbance to which it is exposed by the action of the sphincter, and thus it degenerates into a fistula, which, when it is perfect, communicates at one extremity with the bowel, and at the other with the external surface. In consequence of the tendency in matter to spread where there is little resistance, or where from position it may become dependent, burrowing takes place in various directions about the inferior portion of the rectum, and several openings may form near the anus. In a great number of cases only one external opening is met with, and this is situated generally about half an inch from the circumference of the anus. In the other cases of a more severe kind, where there has been extensive burrowing of matter, there are two or three openings situated at a greater distance from the anus—as, for instance, over the ischium or in the perineum—and the matter may even extend upwards, and open in the groin.

The external opening may present itself as a simple minute puncture, and when situated close to the anus may be so hidden between the folds of the integument as readily to escape observation, unless it be carefully looked for; the only thing which marks its presence being a slight moisture escaping from one point when pressure is made. In other instances of more extensive and old-standing disease, the opening or openings present themselves as somewhat prominent apertures, not unlike those seen in connection with dead bone, and surrounded by more or less erythema of the skin, so that there is not the least difficulty in finding them.

Although for the most part it will be found that the external opening of a fistula is by the side of and some little distance from the anus, it is well to know the fact that sometimes it is so close to the circumference of the anus that it is necessary for the patient to protrude the parts well before this aperture can be discerned.

An external opening does not always exist, and then is constituted what the older surgeons named a blind or incomplete fistula. This form of the disease is somewhat rare, and it is very likely to be overlooked or misunderstood.

The internal opening of a fistula nearly always exists; and indeed, according to that view which looks upon the formation of the disease by preliminary ulceration of the mucous membrane, an opening must necessarily obtain; but there is no doubt that there are cases of incomplete fistula where there is no opening into the bowel; an examination on the living body alone might not be a sufficient proof of this, for the opening may exist, and not be ascertained; but no such source of deception can occur after death. There are three specimens in St. George's Hospital Museum, as well as two preparations in the Museum of St. Bartholomew's Hospital, which show this. On careful examination, however, it will be noticed that the mucous membrane of the rectum at the spot where the opening would have existed is very much thinned.

Formerly it was considered that the internal opening was situated much higher up than is really the case. Subsequent investigations, however, and especially those instituted by Sabatier, Ribes, and Velpeau, have proved that in the larger number of instances the internal opening is situated within an inch or an inch and a half from the anus. In more rare cases, however, it happens that the internal opening will exist as high up as three inches from the anus. It is rare that more than one inner opening exists; and it has been affirmed by a recent writer that it is always single; but this is an error, as cases are occasionally met with where there are two or more distinct apertures in the gut. And it is easy to understand how this occurs; for in some of the more severe cases of abscess near the rectum the matter extends and strips up the gut, separating it from the cellular tissue to the extent of three or four inches; and it is but likely that the mucous membrane should become thinned,

and ultimately perforated, by the pressure of the matter at more points than one.

The course which the sinus takes differs; it may be simply subcutaneous. Very frequently it runs through the fibres of the external sphincter, or it may be found to traverse the substance of the levator ani. In one very beautiful preparation in St. George's Hospital Museum the fistulous canal is shown to be running closely beneath the fibres of the internal sphincter.

Sometimes the result of extensive suppuration around the lower part of the rectum is the formation of a double fistula, either complete or incomplete; that is to say, there may be a fistulous tract on either side, having an internal as well as an external aperture; or a sinus may exist on either side of the bowel, and yet there be only an opening into the latter on one aspect; or there are two sinuses, one of them opening both into the bowel and on the skin, whilst the other has only an internal aperture. There is occasionally also a curious condition, where the fistulous sinuses surround the back part of the rectum, and have a common opening in the bowel; this form of the disease has been not inaptly called the *horseshoe* fistula. In very severe cases the sinuses are found to be branching out across the buttock in various directions; this state is not uncommonly associated with stricture of the bowel of either a simple or malignant character. In an instance which I lately saw in consultation with Mr. Holberton, of Hampton, the sinus extended so far down as the lower third of the thigh posteriorly. The fistula in this case was the result of stricture one inch from the anus. [Occasionally the fistula runs forwards, so as even to involve a portion of the scrotum; but I have never seen this condition except where the posterior portion of the perineum was also extensively burrowed.]

The causes which produce fistula are various, and, understanding its pathology, we must look to those circumstances which are liable to excite inflammation and suppuration about the rectum. In some rare cases the disease is of a traumatic origin. Thus a fish-bone may have adhered to the mucous membrane of the rectum, and produced ulceration and subsequent abscess, which has degenerated into fistula; or the ulceration may have primarily taken place in the mucous membrane in persons who have suffered from severe dysentery. [Seeds sometimes lodge in the pouch-like folds of the mucous membrane of the rectum, already referred to at p. 643, and induce great irritation, ulcerating their way into the areolar tissue, and causing abscess, but not necessarily fistula.] In the greater number of cases, however, when abscess has been the primary step, the morbid action has been idiopathic, occurring in persons who have been out of health, or who have been ill from some specific disease. Those who have lived long in tropical climates, and who have suffered from disease of the liver, are doubtless more liable than others to get fistula. A violent blow upon the perineum or ischio-rectal region will produce abscess which will terminate in fistula. I have recently operated upon a very healthy young man where the disease could be traced to this source.

When an inner opening exists without any external aperture, the diagnosis is somewhat difficult. The patient will complain of having suffered from more or less pain about the rectum; this had gradually become more severe, until there was perhaps some alleviation, accompanied with a discharge of purulent matter from the anus. On examination, the surgeon will detect a distinct and circumscribed induration by the side of the anus, very painful to the touch; and on pressing the part towards the anus purulent fluid will be observed to escape in considerable quantity. And when the integument has become thinned, fluctuation may be discovered; but not in all cases.

It should not be taken for granted that, because a sinus exists close to the anus, it must be connected with the rectum; for abscess and fistulous openings may exist in connection with disease in other parts. Thus sometimes an ordinary pelvic abscess may discharge itself close to the anal aperture, or an abscess in communication with the hip-joint will open into the ischio-rectal fossa. An abundant discharge from a cavity connected with the prostate gland took place in this situation in a recent case under my own care. Necrosis of the tuberosity of the ischium or of the extremity of the sacrum may exist, and the aperture in connection with the disease may be present in the same situation.

I attended an elderly gentleman some time since who had suffered for several years from a fistula. Two operations had been performed upon him by a most eminent surgeon, but the fistula remained unhealed. When he came under my observation, a most careful examination was made with the view of detecting the cause of the failure of these operations; and by passing the probe up to the posterior part of the rectum, a portion of necrosed bone was felt. The fistula was freely incised, and a small piece of the sacrum was removed. The existence of this disease had been overlooked, and hence the failure of the two previous operations, which had been performed as for an ordinary fistula in ano. I may mention that after the third operation the patient perfectly recovered.

In order to bring about the cure of a fistula in ano, it is necessary in the great majority of cases to perform a surgical operation, which fortunately, from the attention devoted to this disease by Pott and others, is a much more simple business now than it was in former days, and if proper judgment be used in selecting the cases, is almost always attended with success.

Before, however, proceeding to consider more especially the treatment for the disease when the fistulous communication has been formed, it is necessary to make some observations on the importance of dealing promptly with the inflammatory and suppurative process which forms the first stage of the affection. When a patient is suffering from the symptoms of threatened abscess near the rectum, he should lie in the recumbent posture, and the bowels should be thoroughly evacuated by a dose of calomel, followed by castor-oil; hot fomentations and poultices should be assiduously employed, and the diet must be sparing. By the early adoption of these measures threatened abscess will be arrested, and all the symptoms subside. If, however, there be good reason to believe that matter has already been formed, it will be necessary, in order to prevent a fistula, to make a free incision into the centre of this swelling with a narrow sharp bistoury. In some cases, where the pus is deeply seated, the point of the knife must be passed much further than would at first appear to be necessary. In such a case the evacuation of the abscess will be facilitated by the introduction of the left forefinger into the gut; by its assistance the swelling may be pushed forwards and made more prominent. When the abscess has been opened, it will be prudent to insert a small portion of lint into the aperture, in order to prevent its closure. The part should then be well poulticed, and the patient should remain quiet during a few days.

In many cases, where the inflammation of the cellular tissue has not existed long, and where the general health is not much at fault, an abscess close to the rectum will completely heal by this prompt evacuation of its contents, and thus the fistula will be prevented. Hence is shown the vast importance of properly understanding the pathology of this disease, and thereby being able to arrest it in its first stage.

In those cases, however, where there has been extensive mischief, and the lower part of the rectum has been much denuded, or where the general health has been weakened from this or some other cause, even this prompt surgical treatment will not prevent the abscess from degenerating into a fistula; and in other very numerous cases, the abscess has been allowed to burst, and the fistulous communication between the gut and the external surface has been formed.

In some cases where the sinus is short and free from induration, it may be made to heal by the employment of irritating injections thrown into the canal. Those which are likely to prove of most service are injections composed of the pure tincture of cantharides, or of the tincture of iodine undiluted, which should be used daily. Another method of healing these fistulæ consists in irritating the sinus by passing a silver probe covered at its extremity with fused nitrate of silver. Each of these measures is occasionally successful, especially when, at the same time, the general system is improved by medical treatment and by change of air. Therefore, in those cases where there is no cause for hurry, or where the patient is unwilling to undergo an operation, these means of cure should be tried perseveringly, and both patient and surgeon will sometimes be rewarded with success.

Fistula in ano may be treated successfully by ligature, and it is a method which has of late years been warmly recommended by Mr. Luke. The operation is effected by passing a common ligature, by means of an eyed probe, through the external aperture into the bowel; then adapting the two ends of the thread to a small screw, which can be tightened from time to time as the ligature is cutting its way out from the fistula. The process of separation is generally completed in a week or ten days; and as the ligature ulcerates away, the cavity behind becomes gradually filled up. The mode adopted and the instruments used by Mr. Luke are described in the Lancet for 1845, p. 221.

[A very easy method of introducing the ligature is as follows: A somewhat bulbous-ended probe is passed through the fistula into the bowel, and the surgeon then, holding the probe with one hand, carries his other forefinger into the bowel, carrying the middle of the ligature in the cleft of the nail; the end of the probe being now engaged between the ligature and the finger, the latter is withdrawn, when by twisting up the two ends of the thread, the end of the probe will be tightly embraced, and can be drawn out again, bringing the double thread with it.

Now by tying the two ends through the loop, the requisite amount of pressure may be made, and changed from day to day until the tissues are cut through. Or by attaching an elastic cord to one end of the thread, drawing it through, and tying its ends tightly together, a continuous pressure may be made which is very effectual. I have found this plan

an admirable one in a large number of cases.]

There are some advantages in the ligature. Thus, it may be employed without fear of producing hemorrhage; and therefore in those rare instances where the inner opening of the fistula is situated high up, and where serious bleeding may be expected to arise after a cutting operation, this mode of treatment should be adopted. Again there are patients every now and then to be met with who are so nervous about a cutting operation, that even with the promise of chloroform they will not submit to the knife; in such the treatment by ligature can be advantageously substituted. It is not a method adapted to cases where the sinuses are very tortuous, and extend in various directions; but in those instances where the fistula is simple, there is no doubt that the application of the ligature will be followed by success, although the process is a somewhat tedious one, and sometimes it has to be abandoned in consequence of the pain and annoyance caused.

In by far the majority of cases of fistula in ano, an operation by the knife—that commonly denominated *the operation for fistula*—is needed, if a satisfactory and efficient cure be looked for. This consists in the division of the structures situated between the sinus and the cavity of the intestine, and, in fact, the laying open of the entire fistula from one orifice to the other. This proceeding is rendered necessary in many cases of obstinate sinuses situated in other parts of the body; and it is easy to understand how imperatively it is called for when a sinus implicates a part periodically acted upon by a powerful sphincter muscle, whose contractions alone will suffice to prevent the healing of the fistula, even were there no other causes at work to impede this process. The object, therefore, of the surgeon in performing the operation is not only to lay the sinus open, and thus place it in a more favorable condition to heal, but by dividing the sphincter muscle to paralyze its action for a time, and thus to keep the wound at rest—a proceeding found to be essential for a cure, not only here, but in the treatment of wounds, sores, or injuries in other parts of the body.

The operation, as performed now, is, in the majority of cases, a simple one, compared with the same before, or even after, the days of Pott, whose writings tended so powerfully to diffuse correct views regarding the pathology and treatment of fistula in ano. Instead of excising the fistulous tract, or even of making very free incisions high up in the gut, the surgeon only finds it needful to divide those structures which are limited by the two orifices of the sinus; and it is now pretty clearly ascertained that in the majority of instances of the disorder, the inner opening is met with at a point not higher than an inch, or little more, from the anus; and it is not necessary to carry the incision higher into the rectum, even though the sinus may extend for some distance by the side of the bowel above the opening.

The operation is performed in the following simple manner:—

The patient, who has had the bowels well cleared out previously both by castor-oil and by an enema, and who has been rendered insensible by chloroform [or ether], lies upon his side; an assistant separates the buttocks. [The best position for the patient is on the left side, with the right leg drawn up.] The operator introduces his left forefinger, well oiled, into the rectum, and then passes a curved, narrow-bladed bistoury with a blunt point through the external opening, and carries it along the sinus until the point is made to enter the bowel through the internal opening and to come in contact with the forefinger, the bulb of which is turned towards the orifice of the sinus. This being effected, the surgeon, by a kind of sawing motion with the hand holding the knife, and assisted by the left forefinger, pushing the instrument downwards, divides the whole of the structures between the sinus and the anus, bringing out both knife and forefinger together. In those cases where the sinus is single, this one incision is alone necessary; but where there are one or more tracks branching off, the bistoury must be carried along them, so that the undermined integument may be fully opened and the wound made one.

If it has been ascertained that an internal opening does not exist, the knife [or a grooved director] must be forced through the mucous membrane into the cavity of the bowel at that spot where the tissue is found to be thinnest, and the operation should be then completed. It is not necessary to carry the knife to the very extremity of the sinus, if this extends to a considerable length, whether there be an inner aperture of the fistula or not.

After the operation is completed, a small strip of oiled lint should be placed lightly between the edges of the wound, but there should be no plugging or thrusting in of large pieces; a pad and bandage may then be lightly yet firmly placed over the parts; the patient should be kept quiet in bed, and should have a dose of chalk-mixture and laudanum, in order that the bowels may be confined; his diet should be such as not to cause much fecal

accumulation. At the end of three days a dose of castor-oil should be given; and after the bowels are evacuated, the wound should be cleansed and dressed again. A small portion of lint should be introduced from day to day within the edges of the wound; and if it look flabby, a solution of sulphate of zinc or of copper may be employed by means of the lint. In the majority of cases, if there be nothing adverse, the wound made in the operation will heal up soundly in two or three weeks. In some cases, however, without any appreciable cause, the healing process will be retarded; a useful remedy in such a case is the confection of black pepper, in drachm doses, every night; or it may be needful to send the patient away for a change of air, when the wound, which has hitherto become stationary, will often commence healing again rapidly.

[The following operation, a sort of compromise between ligation and cutting, has recently been proposed by Reeves, who calls it, not very appropriately, "immediate ligation":—

"It consisted in passing a strong and well-waxed silk ligature along the track of the fistula into the bowel. An ordinary surgical probe, with an eye at its end, carried this thread into the rectum. My bivalve expanding speculum was previously introduced, and by its use there was no difficulty in seeing and seizing the ligature and bringing it out through the anus. The probe was then withdrawn, and the ends of the silk were wound round two strong pieces of wood, which were held between the fingers of each hand. An assistant passed a finger on either side of the track of the fistula, to steady the tissues, and to resist the traction which was put on the silk thread. The two pieces of wood were then drawn towards me with a rapid sawing motion, and the fistula was quickly divided with the loss of scarcely any blood. Some oiled lint and a pad and bandage were applied in the usual way, and the wound healed well. No anæsthetic was administered, and although the patient did not relish the operation, still it was quite bearable, and what she felt most was a burning sensation, due, doubtless, to the friction of the silk."]

Before undertaking the operation for fistula, the surgeon should take especial care to examine the patient, not only locally, but as to the general state of health; for this disease is not unfrequently complicated with other morbid states, which may either render any cutting operation unadvisable, or may induce delay in order that some preparatory measures may be adopted. Thus it is well known that fistula in ano is not unfrequently associated with pulmonary disease; and if this be found to exist it certainly would not be prudent to perform the operation, unless the suffering from the local affection should be very great, and the mischief in the chest be very slight. If the fistula be cut when the patient is suffering from phthisis pulmonalis, the wound, in the majority of cases, will not heal up, even though life may be spared for a considerable time.

There are other cases also where fistula is met with in persons who have had their health broken down by a long residence in hot countries, and have suffered from dysentery and disease of the liver; or cases are seen where either the liver or kidneys have become structurally altered by free indulgence in ardent spirits. An operation in such instances is generally to be avoided, unless there be some urgent reason for its adoption. [The ligature may, however, be generally used with perfect safety in any case.]

When a fistula is connected with a stricture of the rectum, a careful consideration of the case is required. If the obstruction be of a malignant nature, of course any operation is not to be thought of. It may, however, be somewhat difficult to ascertain at the early stage of the affection whether the stricture be of a malignant character or otherwise, and the fistula in connection with it may have been divided. In this case, either this wound will not heal, or its cicatrix will put on a scirrhous character.

I was called to see a middle-aged woman, who had been operated upon on two occasions for fistula, unsuccessfully, by a surgeon of large experience. On examination, I found that the wound had only partly healed, and had taken on a scirrhous character. On examining the rectum, I found that there was a firm indurated stricture, about an inch up, and there was much hardness about the parts altogether. I gave an opinion at the time that it was a question whether the disease was not of a malignant character, although the features were not decided. At any rate, the ill success attending the operation for the fistula was due to the existence of the disease, which perhaps at the time was overlooked. I ascertained from a medical friend that this woman died six months afterwards, and that the disease had manifested itself as cancer.

If a fistula be complicated by a simple stricture of the rectum, and this latter be overlooked, the operation will in all probability fail. When the stricture is recognized, preliminary treatment is to be employed before the knife is used. The contracted part should be dilated by the bougie, and subsequently the sinus is to be laid open; during the after treatment, too, this use of the bougie must be strictly adhered to, otherwise contraction will recur, and the sinus will not close. When the inner opening of the fistula is situated above the stricture, this latter may be

divided at the same time that the sinus is laid open; but it is better even in such a case to employ the bougie prior to the operation, if there be not any decided objection to this proceeding.

Every now and then a weakness or entire loss of power of the sphincter occurs after its division, more especially in those instances where two or three operations have been rendered necessary. In three instances which have lately presented themselves to my notice the operation had been repeated thrice in two of the patients, and twice in the other. In two out of the three the loss of power was complete; when it is but partial, recovery may take place after the parts are thoroughly and soundly cicatrized.

In some rare cases there will be an external opening on either side of the rectum, with only one inner aperture. It then becomes a question as to what should be done. The operation performed on that side where the inner opening exists, together with slightly enlarging the mouth of the sinus on the other, will sometimes suffice; but if this is found to be ineffectual, both the fistulous tracks must be freely incised. The objection to this double operation consists in the circumstance that loss of power over the sphincter may ensue. When there is a complete fistula on both sides, a double operation must be performed, and it should be effected on one occasion.

[Here the treatment by ligature will be especially applicable, both sinuses being included, each in a separate loop.

Scraping away the walls of the fistula with an instrument resembling a very small spoon, with serrated edges, has been sometimes done; but seems to present no advantages over the other methods of treatment already detailed.]

Ulcer of the Rectum and Anus.

The lower part of the rectum and the immediate circumference of the anal orifice are subject to ulcerations, which are peculiarly interesting and important, inasmuch as their existence is attended with some striking phenomena; they are productive of an excessive amount of suffering, and when carefully and judiciously treated are easily remedied. The various breaches of surface which are found involving either the mucous membrane or the skin itself at the extremity of the rectum, although differing in regard to situation and size, have this one common feature, viz., acute sensibility. There are, perhaps, few instances of morbid action so limited, producing such extreme distress and discomfort, as painful ulcer of the rectum. The reason is obvious—it is the periodical action of the sphincter which causes this great sensibility, independent of the usual amount of pain experienced from the presence of ulcerations existing at the outlets of the cavities of the body, as for instance the lips and urethra.

The simplest form in which these ulcerations are met with is that where there is a breach of surface at one or more points around the anus, not extending within the orifice; in such a case the entire extent of the mischief may be readily detected, if the patient be told to extrude the parts. On introducing the finger into the rectum, the mucous membrane is felt to be quite healthy; the patient complains of a smarting as the motions are passed, and the uneasy sensation or pain remains only for a few minutes, then goes off entirely: it is necessary to attend to this point very carefully in the examination of such a case, for only by this means shall we be able to determine between this and the ulcer which is seated within the sphincter.

These ulcerations are for the most part observed in persons who are not attentive to cleanliness, and more especially in the lower order of prostitutes, who have suffered from vaginal discharges; in all probability the mere mechanical contact of the gonorrhœal matter with the sensitive skin around the anus, and its retention there, are quite sufficient to produce the mischief.

The treatment necessary in such cases is, first, strict attention to cleanliness; the patient should be desired to apply warm water to the parts two or three times a day thoroughly, by means of a sponge. The solid nitrate of silver should be used once or twice to the ulcerated surfaces, and subsequently the application of the red precipitate ointment or of the lotio nigra will bring about a speedy cure. It will be necessary to attend to the state of the bowels; and the surgeon should not forget to inquire if there be any vaginal discharge; and should there be any, to put a stop to it by suitable injections.

The variety of ulcer next to be considered, and that which is more frequently seen by the surgeon, in consequence of the greater distress which accompanies it, is that where the ulceration is situated partly without the anus and partly within the rectum. The existence of this form of ulcer is not unfrequently overlooked, because, although the symptoms are peculiar and striking, the pathological change causing them is not readily detected, unless by one accustomed to look for it. The patient who is suffering from this form of the affection will complain of having what he terms the piles; on ques-

tioning him closely, it will be ascertained that there is not any protrusion, but that he feels more or less acute pain in passing the contents of the bowels. This pain, instead of diminishing, increases in severity after the act, and lasts for a considerable time, varying from a quarter of an hour to four or five hours; it then ceases, and there is no suffering until the bowels are again moved, when a repetition occurs; and as time goes on the symptoms become more severe. There is also in some cases a discharge of blood, and in all a more or less purulent discharge. On examination there will be nothing visible externally, with the exception, perhaps, of a small excrescence or pile about the size of a currant; this is found in a large proportion of cases of ulcer of the anus and rectum, and is a sign of great importance. On requesting the patient to protrude the parts as much as possible, and separating the sides of the anus very carefully, the ulcer will be seen situated at the base of the little tumor, which in nine cases out of ten is at the posterior border of the anus. In one case the ulcer may be only the eighth of an inch in length, and its extent may be defined by the eye alone; in another instance it may be more than half an inch in length, and, extending beyond the verge of the anus, implicate the mucous membrane of the rectum itself. When this is the case, the limit of the ulcer cannot be seen, but it is necessary to introduce the finger into the rectum, when the peculiar and roughened sensation caused by the breach of surface is readily detected by a practised hand. This introduction of the finger is accompanied generally with excessive pain. The ulcer may be either round or oval. In one case lately under my care there was a peculiarity regarding this; for instead of there being only one external excrescence posteriorly, two existed, a little apart from one another, and an ulcer of considerable size extended from the base of either of these tumors to within the sphincter, narrowing as it encroached upon the cavity of the gut, thus forming a complete triangle, with its base towards the tumors. Instead of being so large as this—which is rare—the ulcer may not be bigger than a large pin's-head or a small split-pea: its surface is either smooth, the mucous membrane, when the very verge of the anus is the seat, being simply denuded, or it is somewhat rough and excavated when the integument is more implicated, and the appearance of the ulcer presents a healthy red or ashy-gray color. In some cases there are two ulcers, separated more or less by a raised process of integument, so as to become nearly distinct.

It is extremely important to employ the greatest care in the investigation of these cases; for a small ulcer may be easily overlooked, in consequence of the rugæ around the anus enveloping the part and hiding it from sight. It is well, therefore, when this disease is suspected, to have a good light, and to take care that the examination be not made until the bowels have been well evacuated and the parts well cleansed. With regard to the pathology of this affection, it is difficult to come to any correct conclusion. In all probability some breach of surface, at first slight, is produced by violent straining; and from the periodical movement of the part, and want of cleanliness and attention to the bowels, the ulceration increases, and assumes the definite form in which it is presented to our notice; in other cases probably the commencement of the disease consists in circumscribed inflammation and abscess ending in ulceration, which is limited to the mucous membrane or skin respectively. In most cases the sphincter is found to act very strongly, so that considerable opposition is made to the entrance of the finger when it is introduced for the purpose of examination. This spasmodic condition of the sphincter ani is supposed by some writers, as Mr. Copeland and Mr. Syme, to constitute a peculiar affection; but it is doubtful whether the effect in question is not rather one of the prominent symptoms of an ulcer at the orifice of the anus. There is good reason to believe that, in all or most of these cases of spasmodic constriction of the anus, a diligent search would bring to light some slight ulceration or excoriation, on which the symptoms depend. One of the most recent authors of repute, Mr. Quain, holds the view that the sphincter is but secondarily or sympathetically affected, and that the painful spasm is not a disease in itself.

I think, perhaps, that I have more frequently met with this affection in women than in men; and most certainly they are more liable to other morbid conditions which produce much the same kind of symptoms as those afforded by the painful ulcer. Amongst these I may mention the displacement of the womb, which pressing upon the rectum gives rise to a difficulty and pain in defecation; that painful condition of the coccyx which is the result of an injury, produces also very similar symptoms. I saw recently a very marked case of this kind, where an eminent physician-accoucheur considered that an ulcer of the rectum existed, whereas, on examination, no such lesion was found, and appropriate remedies applied over the coccyx soon brought about a removal of the symptoms complained of.

The treatment of this affection consists either in the employment of local agents,

or in the use of the bistoury. In those cases where the ulceration is only of slight extent, is not carried far within the sphincter ani, may be comprehended by the naked eye, and the symptoms have not long existed, a cure may be brought about by careful attention to the bowels, by the employment of rigid cleanliness, and by an occasional application to the ulcerated spot of the solid nitrate of silver or sulphate of copper. After the sore has been touched once or twice, the effect will be, in those cases which are benefited by this treatment, a considerable mitigation of the severe pain which has troubled the patient when at the closet and afterwards; and the sore, instead of presenting the grayish appearance which is usually observed, puts on healthy granulations, and slowly contracts in size. In order to assist this process, a lotion of sulphate of copper or sulphate of zinc, one grain to an ounce of water, should be applied two or three times a day; or if these do not succeed, the ordinary black wash may be used with benefit. The daily introduction of a full-sized bougie, made of wax or of yellow soap, will sometimes act beneficially, by distending the sphincter, and producing such an amount of irritation as will set up a healing process in the sore.

In the more severe cases, however, this local treatment will fail to produce a cure; and there are some persons who have been brought to such a state of suffering, local and general, that it will be unwise to trust to measures which either may not succeed, or which may be slow in giving relief. A modification of the operation which was originated by the French surgeon Boyer, and which consisted in the division of the sphincter and the tissues around, is now generally undertaken by the best surgeons, and is found to be successful in remedying this affection. The French surgeon and those who had adopted his operation were induced to make a complete division of the sphincter ani, under the impression that the muscular constriction was the cause of the ulcer, and that the pathological effect could not be removed unless the action of these fibres was temporarily destroyed. This severe operation doubtless succeeded in bringing about a cure; but it was reserved for the late Mr. Copeland to show that it is only necessary to make a fair incision through the ulcer or fissure itself without cutting the sphincter. Sir B. Brodie, Mr. Syme, and Mr. Quain have also advocated in their writings this limited operation; and it is now almost universally acknowledged, that if the ulcer be fairly divided in its long axis, the same relief is produced as though the sphincter was divided, and the operation itself is much less severe and painful. The relief which is given to the patient is most remarkable. In a few hours the aspect of suffering, which is so well marked in most of these cases, is almost entirely removed; and even on the first evacuation of the bowels after the operation, the patient feels scarcely any pain beyond that produced by the raw surface of the wound.

The operation itself is simple and easy of execution. The bowels having been well cleared out previously by a dose of castor-oil or an injection, the surgeon should then take a straight narrow-bladed, *probe-pointed* knife, and having passed his left forefinger into the rectum beyond the extremity of the ulcer, he should introduce the point of the knife very carefully, and commencing his incision above the ulcer, carry the cutting edge fairly and quickly through the centre of the sore or fissure. It is absolutely necessary to include the whole length of the sore, and not to cut to one side; and therefore it is well that an assistant should open the orifice of the anus as far as possible, in order that a good view of the greater part [the whole] of the ulcer should be obtained by the operator. There is very frequently a small external pile or thickened fold of integument at the base of the sore; this should also be removed, as well as any other pendulous flaps of skin which may encircle the anus. [Or an internal pile or polypoid growth may hang down over the sore, and should be tied at its base.] Scarcely any dressing is required after this operation; a small strip of lint dipped in oil may be introduced, and kept in for a day or two, but it is not necessary. It is as well to give an opiate after the operation: in the first place, to lessen pain, and secondly, to prevent the action of the bowels, which should not be allowed for two days or more; and then this action should be produced artificially by a dose of castor-oil. The wound should be daily dressed with a dossil of lint dipped in a weak solution of sulphate of zinc and water. This dressing is not absolutely necessary; but there are some cases in which the wound becomes sluggish, and then a slight stimulation is desirable. The use of the confectio piperis nigri will assist the healing of the wound after this operation, as after that for rectal fistula.

Certain precautions and modifications with reference to this operation have been suggested by surgical authors: thus Sir B. Brodie has cautioned surgeons not to make the incision towards the vagina in the case of a female, for fear of the occurrence of loss of power over the sphincter vaginæ; others have suggested that

the incision should be made on either side of the anus, in order that the sphincter muscle should be effectually divided: but now that it is not found necessary to do more than simply incise the ulcer, and in the most severe cases only to divide some of the fibres of the sphincter, the surgeon need not obey either of these injunctions, but be content with making a fair incision through the diseased part, wherever it be situated. The posterior part of the anus is found to be the seat of the affection in by far the majority of cases; sometimes the ulcer is found on one side, and very rarely it is seen on the anterior aspect; thus, out of twelve cases which I have recently met with, the ulcer existed in front only in one instance, whereas in all the others the disease was seated behind. It is very necessary to make a careful examination of the rectum at the time of operating, for it is very possible that a polypoid growth will be found to exist in conjunction with and above the ulcer, and which may easily escape observation. I have quite accidentally discovered these growths more than once lately after I had completed this operation and had introduced the finger high up into the bowel for the purpose of passing a suppository. If one or more of these growths were left behind, it is probable that the cure would not be complete, or at all events their presence might produce a return of the ulceration; for I believe that not unfrequently it is the presence of this polypoid growth that originates the fissure or ulcer.

It has lately been recommended in France, that an operation effecting the same purpose as division of the ulcer should be performed. This consists in the forcible tearing open of the sphincter by the introduction of the two fingers into the anus, and using extension. There has been sufficient evidence placed before the profession to prove that this mode of dealing with fissure of the rectum is attended with success; but it is a proceeding so rude and unsurgical, that we trust the surgeons of this country will not forsake the simple and effectual means we have described when any operative measure is required.

[This procedure has found favor with many surgeons in America, and is highly spoken of by Dr. Van Buren, of New York (Lectures on the Surgery of the Rectum, etc., 1881). A better method of effecting it is, as before described, by inserting the two thumbs, back to back, in the bowel, the fingers being spread out toward the ischia on either side; then by a firm and gentle separation of the thumbs the sphincter may be sufficiently stretched. Much less pain or irritation follows than would be supposed.]

There is a form in which *fissure of the anus*, in the true sense of the term, occurs, and which should not be considered as the same affection we have before described, although they are by most writers classed together under the same head. Thus the ulcers of the lower part of the rectum and anus are called by several surgical authorities *fissure of the anus*, whereas the term "ulcer of the rectum" is much more applicable; for although to a careless observer the disease may have only the appearance of a fissure, on a more careful examination there is found to be a well-defined breach of surface, varying from an eighth to a quarter of an inch in breadth; and the true painful ulcer, independent of syphilitic or gonorrhœal infection, always involves the mucous membrane of the rectum itself. In that form of the disease to which the term "fissure of the anus" may well be applied, the affection consists in one or more cracks or streaks of excoriation, or superficial ulceration, situated between the folds of the muco-cutaneous surface immediately at the anus itself, involving the rectum but slightly. They produce a considerable amount of uneasiness, smarting, and itching; and, from the periodical action of the anus, the cracks or fissures become deeper and longer, and thus are troublesome to heal. Sometimes excruciating suffering, as is noticed in the true painful ulcer, exists; and on the most scrupulous examination nothing but a long crack or streak of excoriation of the kind mentioned can be seen, and it is reasonable to infer that the suffering is produced by this very slight disorder; it is not difficult to account for it, considering how extremely susceptible some persons—especially females, in whom this condition of the anus is mostly observed—are of painful impressions.

The treatment to be adopted in such cases is, in the first place, to endeavor to procure regular and healthy evacuations of the bowels, and to use scrupulous cleanliness after the motions. A considerable number of persons who suffer from this affection are those who sit a great deal. This should be avoided as much as possible, and plenty of exercise should be taken. The application of the solid nitrate of silver on one or two occasions will sometimes cure the disease; or a lotion composed of from four to ten grains of the same to an ounce of water may be applied to the part carefully by means of a camel-hair brush every other morning. The ointment of oxide of zinc, or one containing chloroform, will sometimes be equally useful in allaying the irritation and healing the part.

If, however, as will sometimes happen, none of these measures succeed in giving relief, and the patient suffers from con-

tinued distress after the evacuation of the bowels, an incision should be made through the fissure; the part will subsequently heal, and the troublesome symptoms disappear.

Stricture of the Rectum.

Like other mucous canals, the rectum is liable to a contraction of its cavity; and although this disease may not be considered to be one of very frequent occurrence, it is by no means rarely met with, several cases generally presenting themselves annually at the various public institutions.

[It would seem to occur sometimes as a congenital affection (Reynier, Des rétrecissements valvulaires congenitaux du rectum, Gaz. Hebd. de Méd., 1878, p. 759). Van Buren (op. cit., p. 270) proposes to classify these affections as (1) *Congenital*, which are usually valvular; (2) *Cicatricial*, arising from traumatism or ulceration, with loss of substance; (3) *Fibrous*, arising from hypertrophy or hyperplastic exudations, undergoing fibrous change, as in syphilis. (This does not, of course, include malignant or cancerous strictures.)]

The disease consists essentially, in most cases, of an adventitious deposit thrown out upon or around the coats of the intestine. In the most simple form of stricture there is a more prominent ring of apparently hypertrophied mucous membrane, either entirely or only partially surrounding the cavity of the gut. A careful examination on the living body with the finger, and an investigation of the diseased part after death, shows that the thickening is produced in the areolar tissue underneath the mucous membrane; although there are preparations to be met with which lead to the belief that the encroachment upon the cavity of the gut is caused merely by a prominent fold or ring of the mucous membrane itself. In the more marked cases of the disease, not only is the deposit found in the submucous cellular tissue, but there is a thickening of the muscular coat as well, produced, not by hypertrophy of this investment, but by an infiltration of the fibrous exudation through the meshes of the muscular texture. In the more severe cases, where the disease has lasted for a long period, this fibrous deposit becomes more extensive and dense. In most cases there is, together with a very narrow contraction, a large amount of thickening of the coats of the bowel; but every now and then a considerable amount of contraction is found, without any, or with scarcely any, consolidation of the surrounding tissues. In one very interesting preparation in the museum of St. Bartholomew's Hospital, there is a tight contraction of the gut about three inches from the anus, the cavity being diminished to about one quarter of an inch in diameter for the extent of an inch; but there is not any thickening of the tissues whatever, and the contraction is supposed to be owing to muscular action. In some rare instances, the stricture is caused not by any deposit in the walls of the gut, but by fibrous bands running across the cavity of the bowel; thus, in King's College Museum there is a curious specimen, which shows a stricture about one inch and a half from the anus, consisting of a cup-shaped septum formed of thick bands running across, in which are three or four distinct openings which would each admit a small quill.

In a few instances the fibrous deposit producing the thickening—which is the essential feature of the disease—involves only a portion of the circumference of the bowel, as was found in a case of stricture of the rectum lately brought to me for consultation. In by far the greater number, however, the whole circumference of the gut is implicated in the condensation which has taken place. It may be much more decided on one side than another.

The extent of bowel affected lengthwise also varies much. The disease may involve only one or two lines of the gut; much more frequently the deposit extends from half an inch to an inch and a half in length; sometimes the consolidation implicates three or four inches of the intestine; and, in rare cases, there is a general thickening of the tunics, involving nearly the whole of the rectum, and producing a considerable diminution in the cavity of the bowel.

The pathological changes which occur as the result of stricture of the rectum affect the bowel in the immediate locality and behind it; important results are also witnessed in the tissues surrounding or in connection with the bowel.

The intestine immediately above the stricture is, in the majority of cases, more or less dilated; in one instance the cavity being widened only to a small extent, whilst in another, where the stricture has been very tight and of long duration, the intestine is distended in a great degree; thus in one specimen in the Museum of Guy's Hospital, the rectum is five inches in its diameter. There is also a thickening of its tunics above the part immediately diseased, in a great measure owing to an increase in the development of the muscular coat; the law being followed here, that if there be any obstruction to the passage of the contents of a muscular organ, the increased energy necessary will be marked by an increase

in the size and strength of the muscular fibres. The mucous membrane above the stricture is generally in a diseased condition, being either preternaturally vascular and thickened, or, in long-standing cases, superficially or deeply ulcerated, and sending forth a copious unhealthy discharge. Below the seat of stricture there is not much alteration of the parts; the mucous membrane is, however, sometimes found to be inflamed and thickened, or even ulcerated; and there may be thickening and induration of the coats of the intestine, the result of inflammation and suppuration extending from the immediate locality of the stricture.

In addition to these morbid phenomena, which are usual, other serious changes are occasionally seen in connection with stricture of the rectum. Thus the irritation of the disease may produce inflammation and suppuration in the tissues surrounding the bowel; one or more abscesses may form, and communicate not only with the bowel at separate points, but open upon the surface near the anus, or in the front of the perineum. Sometimes a communication exists between the rectum and the vagina or the urethra, and more rarely an aperture forms above the stricture, between the bowel and the cavity of the peritoneum.

The connection between stricture of the rectum and fistula as one of its results is an important one; the two diseases are by no means unfrequently met with together. It is supposed by some authorities that the fistulous opening in the bowel is generally seated beyond the stricture, and that the morbid change is owing to the obstruction and subsequent mischief produced by the stricture; whilst others, among whom is Mr. Syme, are of opinion that the fistulous opening is not owing to the resistance which is offered by the stricture. It is a fact, however, that the opening is not unfrequently found behind the stricture, and that sometimes it is situated lower down. In a preparation lately inspected by me, where fistulæ were associated with a stricture of the rectum, there was an opening into the bowel above the obstruction, and one situated below the stricture. In another specimen, a fistulous sinus runs up along the side of the gut for half an inch above the stricture. In a patient lately seen by me, where the two diseases were associated, I found on examination, that the fistulous sinus opened into the bowel just above the stricture. In some of these cases there can be little doubt that ulceration of the mucous membrane is the first step in the formation of fistula; whilst in others suppuration in the surrounding cellular tissue, and subsequent formation of the sinuses, is the correct pathology.

With regard to the seat of stricture of the rectum, it is found that one particular locality is more disposed to the disease than another. Thus in by far the majority of instances the contraction is met with at the lower part of the rectum, about an inch or an inch and a half from the anus. Observation on the living body proves this; and the result of my examination of the morbid preparations in the various museums was to show that in very nearly one-half of all the specimens, the stricture was found to exist at a point about an inch distant from the orifice. Next in frequency to this part, the disease is met with at a point varying from two to three inches from the anus; it is occasionally met with at four or five inches; and sometimes the contraction involves that part of the gut which marks the junction with the sigmoid flexure of the colon.

The symptoms which are produced by a stricture of the rectum vary according to the extent and peculiarity of the disease. In some rare cases, even when the obstruction has lasted for years, and has materially narrowed the canal, none of the usual symptoms referable to this disease have been experienced until a short period before death, or an examination after death alone has revealed the true nature of the malady. Usually, however, there are well marked symptoms. In some instances the patient can trace the commencement of his disease to a particular time, when he will inform us he suffered more or less severe and persistent pain in the lower part of the abdomen, which was followed by great irregularity of the bowels, necesitating the use of aperient medicine; diarrhœa has probably supervened, the motions being tinged with blood; and this has been followed by constipation, preventing almost entirely the natural action of the bowels.

As the disease advances, the constipation increases, and there is a sense of obstruction about the rectum, which causes the patient to strain violently whilst at the closet; the feces are passed in small quantities at a time, and are much diminished in size [as well as sometimes ribbon-like in shape], as the bowel becomes more contracted; the general health begins to suffer from the retention of fecal matter in the intestines: the abdomen becomes distended; there is marked dyspepsia, with a loaded tongue and general lassitude: and the patient loses his natural appearance of robustness. The local symptoms also become more severe: there is a continual uneasiness about the rectum; considerable pain attending the passage of the feces, which is effected two or three times in the twenty-four hours, in a liquid form; the bladder becomes ir-

ritable; pain is felt in the loins and down the thighs. Occasionally, a large accumulation of fecal matter having taken place above the stricture, there will occur suddenly from time to time a violent attack of diarrhœa, followed by the most obstinate constipation. In advanced cases, one very troublesome symptom consists in the excoriation and ulceration which is produced around the anus by the acrid discharge which takes place from the seat of the stricture. In some cases this discharge is very abundant at the time the patient is at the closet, and is one of the most important diagnostic symptoms.

Although the general health in many cases of stricture of the rectum does not suffer much at first, the disease will, if unchecked, destroy life gradually by the local irritation and suffering, and by the impairment to nutrition almost surely following from constant and long-continued obstruction to the passage of excrementitious matters. In other cases the patient dies suddenly, from symptoms of acute obstruction and inflammation of the bowels, the strictured canal becoming blocked up either by an accumulation of hardened feces, or by some foreign body. In one remarkably interesting preparation in the Museum of the College of Surgeons, a stricture of the rectum which had existed for years had suddenly become entirely closed, lymph being produced by the irritation of a fish-bone which had been swallowed, and which had become arrested at the contracted part.

When the stricture is situated, as it usually is, within two inches of the anus, it is readily felt by the finger, which should be well oiled and carefully passed, because in many cases great pain is experienced by the patient. When the stricture is but slight, involving a small extent or a portion of the circumference of the bowel, the diagnosis will not be so easy as is imagined; when, however, the stricture, as is for the most part found, has encroached on the cavity of the rectum to some extent, the finger readily detects it; for its point becomes entirely arrested by the dense and hard obstruction, or it can only be just insinuated through the diseased part. When withdrawn, the finger is generally covered with a muco-purulent secretion, if the case is at all advanced.

If the symptoms are well marked, and yet the finger cannot reach the obstructed point, it will be necessary either to make the patient strain violently, or to examine him whilst in the upright posture; in this way a stricture which is situated beyond the reach of the finger in an ordinary examination, may be discovered. Should this fail, a wax or gum-elastic bougie, about as large as the adult fore-finger, and well oiled, should be carefully introduced up the rectum. This measure, however, is rarely necessary for the mere purposes of diagnosis, and is open to several sources of fallacy.

[Thus the tip of the bougie may become caught by one of the transverse valvular folds of the mucous membrane; or it may be arrested by striking against the sacral promontory, as pointed out by

Fig. 403.

Rectal bougies of various forms.

Van Buren ("On Phantom Stricture," etc., Am. Journ. of Med. Sciences, Oct. 1879).

The introduction of the whole hand into the rectum for diagnostic purposes has been resorted to of late years; it is claimed to have great advantages, and none of the ill-effects that might be feared.]

In making an examination of the rectum, the surgeon must bear in mind that it may be pressed upon by bodies external to the bowel. An abscess of the prostate gland, especially if of a chronic nature, will so press upon the rectum as to contract its cavity and prevent the passage of the contents of the bowel.

Latterly I had a patient at the Westminster General Dispensary, aged twenty-five, who applied with symptoms of obstruction of the bowels; nothing had passed for a week, and he was in continual suffering, and had become very much reduced in health. On examining the rectum with the finger, I found that the cavity of this gut was almost closed by a large elastic tumor situated in front. The patient had not had any gonorrhœa, but about a month since a catheter had been introduced, and had caused severe pain and bleeding. Since then he had complained of pain and weight about the rectum, and the constipated condition of the bowels alluded to had occurred. I suspected that there must be a chronic abscess mechanically preventing the passage of the feces, and therefore passed a bistoury into the bowel, and made a free incision into the tumor; a large quantity of matter was evacuated, with great relief. The patient was ordered a dose of purgative medicine; this acted freely; and all symptoms of obstruction soon passed away.

The enlarged prostate itself in old people may so press upon the rectum as nearly to obliterate its cavity; the uterus may be retroverted, or a solid tumor growing from that organ may so press on the bowel as to cause the symptoms of stricture. We have seen that the essential pathological feature in stricture of the rectum is a fibrous deposit in or between the tissues of the bowel; and there can be no doubt that the chief instrument in the formation of this product is inflammation of the coats of the intestine of a more or less chronic character. The causes of the inflammation leading to the formation of stricture are various: spontaneous inflammation of the mucous membrane may arise; or the habitual presence of hard fecal matter, exciting frequent attempts to evacuate, will produce it; foreign bodies lodging in a portion of the rectum for a continuous period will bring about the same result. Muscular contraction may cause stricture. I have alluded to one specimen where this, with very good reason, is supposed to have been the cause. Some of the most severe instances of stricture of the lower part of the rectum, or, more properly speaking, of the anus itself, are produced by the cicatrization resulting from wounds made by the scissors in the removal of external piles, especially if the precaution be not taken to excise only the superabundant textures.

Sometimes in these operations large portions of skin, as well as circular fringes of mucous membrane, are cut off; the consequence is, the formation of a tight contraction at the anus. I met with an instance of this kind in the person of a lady who had been operated upon for external piles by one who did not understand his business. Such a tight and unyielding contraction occurred as nearly proved fatal; and the only manner in which life could be rendered at all comfortable was by passing a bougie daily, for the patient would not permit me to divide the stricture.

A by no means infrequent cause of stricture of the rectum is ulceration of the mucous membrane of the bowel, terminating in cicatrization and subsequent contraction of the cavity of the intestine. This is occasionally witnessed in those persons who have lived a long time in India, and have suffered from dysentery. Direct injuries to the bowel will produce stricture, such as the operation for fistula, or the infliction of a wound by means of a bougie or an enema-pipe.

There is one cause, however, of stricture of the rectum which is almost entirely overlooked by the majority of writers, in this country at least. I allude to the venereal poison. As a direct consequence of the application of the poison to the part by means of unnatural intercourse, it is doubtless extremely rare in England; but as one of the sequelæ of syphilis, and as one of the indications of constitutional taint, I believe it is not unfrequently met with. Independent of other instances, two well-marked cases of stricture of the rectum occurring in respectable married women, who had suffered severely from constitutional syphilis, have lately been under my care. In either case the disease distinctly ensued after the venereal poison had been received into the system. Mr. Henry Lee has informed me that he has lately seen three cases of secondary syphilitic stricture of the rectum. Mr. Partridge assures me that he had a case in King's College Hospital where there could be no doubt that the disease was produced by unnatural intercourse. Bushe, in his valuable work, says: "Venereal ulceration of the rectum may arise from direct application of the venereal poison; or it may be consecutive to disease in the genital organs, and then coexists with other secondary symptoms." [Van Buren (Lectures on Diseases of the Rectum, 2d edit., p. 269), speaks of syphilis as a "a pregnant cause of rectal stricture."]

The treatment of stricture of the rectum must be conducted upon the same principles as obtain in the employment of remedial measures for stricture of the urethral canal; and in the first place it must be stated that the surgeon can rarely cure, in the full sense of the word, an organic stricture of the rectum, but he can remedy it in a great measure, prevent its increase, and thus ward off those secondary ills which, almost necessarily, ensue if the original disease be neglected.

The great object the surgeon has in view is to remove the contraction, and to restore the calibre of the gut as nearly as possible to its natural condition. This can in a great measure be effected by the employment of dilatation, in the majority of those cases which are situated within the reach of the finger, and where the primary and secondary morbid changes have not proceeded to a serious state. The agent employed is either the bougie, or some other mechanical contrivance for acting on the stricture as a dilator. The bougie which is most generally used is either made of wax, of gum-elastic material, or of metal. As, in the treatment of strictures of the urethra, various surgeons prefer particular kinds of dilators, so it is in dealing with stricture of the rectum, although one form of instrument may be as useful as another. The wax bougie is a most admirable instrument in the slighter forms of stricture of the rectum, where much pressure is not required; it is also a good form to employ in cases where considerable pain is experienced on the introduction of the finger, or where, from the existence of much muco-purulent or sanguineous discharge, ulceration of the mucous membrane is suspected. It is important to be very particular in cleaning bougies after use. The gum-elastic bougie is the one perhaps which is most generally useful when well made. It is sufficiently firm to compress the stricture well, and yet elastic enough to yield to any obstruction through which it is not intended to pass. The metallic bougie, which is a short cylinder attached at pleasure to a handle, is especially useful in narrow strictures attended with a large amount of induration and situated close to the anus.

Before any attempt is made to dilate a stricture, it is necessary to make a very careful examination, so as to ascertain the exact position and the nature of the stricture. In this manner the surgeon is enabled to ascertain pretty accurately the size of the bougie which should be employed—a step of importance, as thereby the patient is saved much unnecessary probing, and the bougie is passed into the stricture with more facility. If the point of the index-finger cannot penetrate the obstruction, a bougie smaller in size than this finger should be well oiled and gently passed along to the face of the obstruction. A very slight amount of pressure will generally cause the bougie to penetrate the contraction. If it is held tightly, the instrument should be left for half an hour; if, however, the stricture readily yields, a size larger should be passed.

The effect of this operation must be watched, and if no undue irritation be produced, a bougie of somewhat larger size may be introduced on the second or third day, and be repeated at the same intervals, until as large an instrument as the anus can admit is passed without difficulty. In those instances of stricture where there is but a slight amount of thickening of the coats, the rectum may be dilated almost to its natural calibre in a short period; but when there is great induration of the tissues around, and when the diseased part is exceedingly sensitive, the progress of the case will be slow, and attended with delay and difficulty. The patient may complain of great pain when the bougie is passed through the stricture; and its use may be followed by local and constitutional suffering. If the stricture is very sensitive, the wax bougie should be used, and the size increased very slowly. When the instrument is withdrawn, a suppository of opium should be passed into the gut beyond the stricture if possible; and the patient should sit in a hip-bath, and remain perfectly quiet for some hours afterwards.

By taking these precautions, a case of bad stricture of the rectum, which at first sight would appear to be very refractory to treatment, will be brought into subjection much more readily than is imagined. This will especially be the case in those instances where the patients can remain perfectly quiet. In some cases where the act of dilatation is attended with or followed by much pain, it will be desirable to confine the patient to bed; but in those cases where there is not much suffering produced, this step is by no means necessary.

It is a very important matter, during the treatment in question, to attend to the state of the bowels, and prevent accumulation above the stricture. In fact, it is well, before the use of the bougie is commenced, to clear the intestines out by the exhibition of castor-oil internally, and by the use of injections of warm water; and whilst the dilatation is being carried on, the action of the bowels must be brought into as healthy a condition as possible by the occasional use of these remedial measures.

When the stricture is seated beyond the reach of the finger, the use of the bougie is attended with more difficulty, as there is no certain guide to the exact position of the stricture, or to the size of the instrument which it will admit. With very great care, however, the surgeon may dilate a stricture when it is situated several inches beyond the anus with safety; but it must be borne in mind, that the folds of the bowel or the prominence of the sacrum present themselves as obstacles, which may be mistaken for stricture. And the greatest possible care

should be taken not to do mischief; it is a well-known fact that in several cases the walls of the gut have been penetrated by the bougie even where there has not been any stricture in existence.

It has been stated that, in certain instances of stricture of the rectum, there has been a venereal origin; and when this can be pretty clearly made out, the local treatment should be assisted by the exhibition of small doses of mercury and iodide of potassium; the general health will be improved, and we may expect a more speedy absorption of the morbid product constituting the stricture. It will be well also, instead of using oil, to smear the bougie with the strong mercurial ointment. [See an article by Dr. N. G. McMaster, on the treatment of syphilitic stricture of the rectum, in the New York Med. Journ., 1876, p. 376.]

Incision of the strictured portion has been practised by some surgeons; and, as an adjunct to dilatation, it is, in certain instances, a useful means. It is not, however, free from danger. A case came under my observation a short time since, in which death ensued upon the division of a stricture with a knife, and several similar cases have been recorded. This procedure, therefore, should not be adopted unless there is a necessity for it.

Incision is necessary in those cases of stricture, rarely met with, which are of traumatic origin, and situated at the verge of the anus, or within a very short distance; there is generally a dense cicatrix and much induration around, so that dilatation by the bougie is painful and difficult. It is also advisable, if not actually necessary, in old-standing instances of the disease situated in the usual locality and arising from the usual causes, but where, from neglect and continual irritation, the induration around has become excessive, and the stricture most unyielding to the bougie. In either case the operation is best done by introducing the left forefinger into the rectum, and guiding upon that a straight, blunt-pointed, narrow bistoury, with which the stricture is to be divided. Deep incisions must not be made, but the stricture should be simply notched at several points of its circumference. A bougie should be introduced immediately for a minute or two; a suppository of opium is then to be passed into the rectum; the patient must keep quiet for two or three days, when the bougie is to be employed, and continued at regular intervals. In this manner a stricture which previously had defied all attempts to dilate it, will be so far reduced that the patient may obtain great comfort. [See Notta, Deux obs. de rétréc. du rectum traités par l'incision et dilatation; guerison. Ann. Med. de Caen, 1878–9.

The operation of "linear rectotomy," first suggested, according to Van Buren, by Dr. G. M. Humphry, has been revived by Verneuil, Panas, Trélat, Beane, and others. It is simply a complete longitudinal section of the tissues constituting the stricture, for a sufficient distance, sometimes several inches. The galvanocautery has been used, as well as the elastic ligature, in effecting the division in some instances.]

A stricture of the rectum, when once fully formed, is seldom or never thoroughly cured, even under the most assiduous care. There is the same tendency to re-contraction here as in instances of stricture of the urethra; therefore, when the disease has been brought under subjection, it will be absolutely necessary to keep up periodical dilatation; this may, however, be easily effected in the majority of cases by the patient himself. In some cases once a week will suffice; where, however, the disease has been traumatic, it will be needful to pass a bougie every day, or every other day, to prevent re-contraction. [Lawson (Lancet, 1879, p. 512) reports a case of rectal stricture treated by excision of the affected portion.]

If sudden obstruction of the bowels should happen to a patient suffering from stricture of the rectum, it will in all probability depend upon some great contraction having occurred, or upon the presence of a foreign body impacted in the strictured portion. A very careful exploration is, therefore, to be made with the finger, when the condition of the parts will be ascertained. Sometimes it will be found that the stricture has become so narrowed that nothing larger than a quill can be passed into it. Under these circumstances it must be cautiously incised, so as to allow of the introduction of an enema-tube, by means of which injections are to be thrown up for the purposes of emptying the bowels. If a plum-stone or some other foreign body is found to be blocking up the contracted orifice, it must be dislodged; and this may be effected either by the introduction of the finger, or by the use of a pair of forceps, which are to be carefully passed through the strictured part.

When sudden obstruction of the bowels takes place in an instance of stricture of the rectum situated high up beyond the reach of the finger, the patient is placed in the most formidable danger, for it is impossible to ascertain the nature of the obstruction. I have referred to one preparation in the Museum of the College of Surgeons, showing a stricture of the rec-

tum situated near the colon, which had become suddenly closed by an effusion of lymph, the result of a fish-bone sticking in the stricture.

In such cases the long tube must be carefully passed, and the obstruction may be overcome; a large quantity of warm water should then be thrown up. If, however, it is found that the tube cannot be passed, and the use of powerful purgatives is of no avail, death will be imminent; and the only chance of obviating it will consist in making an opening into the colon, either by the method adopted by Littré in the groin, or that suggested by Amussat. The latter operation is that which is usually selected; there are a few cases on record where life has been preserved, and there are instances in which the surgeon is undoubtedly justified in resorting to this expedient.

[The experience of the past ten years has placed colotomy, as a remedy for rectal obstruction, in a far more favorable light than before; and the author of this essay would now probably recommend it much more emphatically. The journals are full of cases in which it has not only lengthened life, but given relief from suffering. Hence the surgeon has no longer to justify himself in resorting to it, but rather to show satisfactory reasons for withholding its benefits in any given case. An exhaustive article on this subject, by Dr. Erskine Mason, of New York, may be found in the Am. Journal of the Med. Sciences for October, 1873; and the method of performing the operation will be given in detail in the article on Operative Surgery in Vol. III.]

Cancer of the Rectum.

In considering the subject of stricture of the rectum, that form of the disease only has been alluded to which is the result of simple inflammatory thickening: there is, however, another condition, where more or less obstruction to the calibre of the bowel is produced by growths which are essentially of a malignant character, whereby the constitution is contaminated, and which render the local disease much more formidable than the simple stricture. The features of distinction between these two particular kinds of the affection are generally pretty broadly marked, and, indeed, cannot well be confounded, when the one we are considering has become fully developed.

Cancer may attack any part of the rectum, but it is perhaps most generally met with in the lower portion; so that in a large number of cases the disease is within the reach of the surgeon's finger, and its character may be readily appreciated. In the very early stage of the disease it appears to commence as a hard deposit between the coats of the intestine; the deposit in some instances consisting of distinct nodules scattered here and there over the bowel; in other cases there will be a complete circle formed by the disease. The actual seat of the deposit is in most cases the areolar tissue, between the mucous and muscular coats. As the disease advances, this is more distinctly ascertained by the circumstance that the mucous membrane, in a more or less healthy condition, is raised up by the deposit underneath it; in course of time, however, this membrane becomes ulcerated, generally in the centre of the deposit.

In more rare instances the malignant deposit is situated between the muscular and serous coat of the bowel, and the morbid growths penetrate into and between the fibres of the muscular tissue. A general thickening and induration of the whole structure of the bowel takes place, so that when a section is made it is impossible to distinguish one texture from another. By this means the cavity of the bowel becomes encroached upon, much in the same way as when the simple fibrous thickening takes place.

As time advances and the cancerous growth increases, the cavity of the intestine becomes encroached upon to a greater extent by the formation of one or more tumors, or nodules, which project into the bowel; by-and-by ulceration of their surface takes place, and in some instances there will be found blended together a large hard nodule of cancer, and a distinct fungous growth with a bleeding ulcerated surface. The morbid growths increase upwards and downwards, involve the rectum to the extent of four or six inches, spread towards the orifice of the bowel, and appear there as warty growths or masses of fungoid disease. It not unfrequently happens, however, that there is a small portion of the bowel perfectly healthy between the anus and the deposit.

The same feature which is associated with malignant disease elsewhere is noticeable here, viz.: its power of diffusion and of attacking neighboring parts; and this is one reason why cancer of the rectum especially is such a distressing malady. On examining specimens of malignant disease of this bowel, which has advanced so far as to terminate life, the surrounding textures and neighboring organs will be found much affected. In one case the uterus or vagina, in another the bladder, prostate, or urethra, has become involved in this malignant action, or subsequent disorganization. A by no means infrequent result of the mischief in the male is the formation of an artificial opening

in the base of the bladder or urethra, and the escape into and blocking up of this canal by fecal matter. In some instances the ulceration penetrates the coats of the bowel, and opens into the cavity of the peritoneum; whilst in others there may be a communication between the bowel and much more distant parts, as for instance the hip-joint. I lately examined a preparation of scirrhus of the rectum, situated about two inches from the orifice; there was a fistulous opening above the stricture, communicating distinctly with an abscess of the hip-joint. In some cases the ulceration which takes place as the result of the extension of the disease is very marked; whilst in other instances there is slight ulceration, but an enormous amount of thickening of the coats and matting together of the various parts around. Sometimes the cavity of the pelvis is found to be almost entirely filled up by a large mass of malignant disease, originating in the bowel. In other cases the peritoneum is thickened with the cancerous matter; the omentum also may be loaded with it, and the liver may have malignant tumors scattered through its texture.

All the different varieties of cancer are seen to involve the rectum; of these, however, the true hard scirrhus is that most frequently met with; next to this, perhaps, the fungoid disease is more often found. Specimens of epithelial and colloid cancer are more rarely, but occasionally, seen.

The symptoms which attend upon malignant disease of the rectum vary much, both according to the stage of the malady and the particular effect the deposit has upon the cavity of the bowel. At the outset the patient complains of an uneasiness about the lower part of the bowel, and an interruption to its proper functions; the feces passing with more difficulty than heretofore; diarrhœa occasionally intervening, accompanied with bloody mucus, and this latter symptom becomes more and more prominent. Thus at first the symptoms are those which depend upon ordinary stricture of the rectum, and the more especially as in some instances there is very little disturbance of the general health. As the disease advances, however, there comes on a greater difficulty in voiding the feces, the act is accompanied with considerable pain, and at each time the bowels are moved there is a discharge of blood. As in ordinary stricture, there is great distension felt, which is now and then relieved by a profuse diarrhœa.

The general health at first is but slightly affected; but as the disease advances, its effects on the constitution become marked; the patient complains of indigestion and flatulence, and of an indescribable depression. His face becomes anxious—presents the peculiar dull aspect of one suffering from malignant disease; and emaciation takes place. The patient is deprived of rest; and indeed there can be few more pitiable objects than some of those who are suffering under cancerous disease of the rectum.

In course of time, the gut becoming more narrowed, and the surface of the diseased textures getting into an ulcerated state, there ensues of necessity a greater hindrance to the passage of the feces; painful attempts are constantly made to pass them, and these efforts are accompanied with an acrid sanious discharge, mixed with feculent and mucopurulent fluids. And frequently this action comes on without the patient having the least control over himself. As the disease involves the surrounding tissues, abscess forms by the side of the bowel, and degenerates into fistula. And when the deposit encroaches upon the bladder, there is either great irritability of that organ, or daily retention of urine; this latter symptom may be produced by the impaction of fecal matter in the urethra. I have lately seen a preparation where a fatal retention of urine proceeded from this cause.

Death generally follows this disease within three or four years after its symptoms are marked. And it is produced either by a gradual sinking of the powers of life, or by the sudden coming on of an attack of obstruction of the bowels.

Fig. 404.

Cancerous growth, protruding at the anus, surrounded by external piles.

When the disease has existed for some time, and is not situated high up in the bowel, the surgeon can have little difficulty in forming a correct diagnosis; and in many cases there is more or less scirrhous induration at the orifice of the

anus, or the disease protrudes externally in the shape of a fungoid mass. In the early stages, however, it is not easy to recognize the true nature of the malady. If the growth be within the reach of the finger, it will be felt as an indurated ring, encircling, or partially encircling, the bowel, as when a simple stricture exists; but in the scirrhous disease the hardness is much more decided and more extensive, the discharge also is of a more offensive and sanious character than it is in the earlier stages of the simple stricture. It may, however, be difficult notwithstanding to ascertain the true nature of the malady at its outset; therefore a cautious opinion must be given.

I saw, a few months since, a patient, about forty years old, who was operated upon twice for fistula, neither operation succeeding. On going to see her after the last had failed, I made a careful examination, and discovered a stricture at the lower part of the rectum. I am not aware that there had been any suspicion of malignant disease, and the only reason which made me suspect its existence was the circumstance of the induration being very decided and extensive. I gavé a cautious opinion, inclining rather to the view that the disease was malignant. This patient has lately died with cancer of the rectum. I may mention that the surgeon who operated upon the fistula was a man of large experience and great skill.

The *treatment* to be adopted for malignant disease of the rectum can offer no other service, unfortunately, than that of palliating the disease, assuaging pain, and prolonging the duration of life. We have seen that, in instances of simple stricture of the rectum, the affection may be cured, or at all events kept under control, by the careful employment of proper surgical means and appliances; because the deposit forming the contraction is merely the result of inflammation, and thus may be absorbed or much diminished by the use of pressure; and moreover, the general constitutional health is not affected as when the disease is of a cancerous nature. Relief, however, can be given to those unfortunate persons who labor under the latter complaint; and it is important to inquire what are the measures best calculated to produce that result.

There is a difference of opinion amongst surgeons as to whether the employment of dilatation is proper. As a rule it may be stated that bougies should not be used in malignant stricture of the rectum; but it is unwise to discard them entirely. When the disease is met with in its early stage, has not ulcerated, is within reach of the finger, and is producing much contraction of the calibre of the bowel, a wax or [gum-elastic] bougie well oiled may be passed gently through the contracted part; and its use may be repeated once or twice in a week, if pain be not produced. In case of extensive cancer of the rectum which had not ulcerated, I employed the bougie in this manner for a long period with the effect of giving relief. It is not to be expected that any absorption of the diseased tissue should take place beyond that which is deposited in connection with cancerous stricture as the mere result of inflammatory action. When, however, the disease has advanced to the ulcerated stage, it would be highly imprudent to use bougies. [Dr. F. N. Otis reports (Hospital Gazette and Arch. of Clin. Surgery, 1877), a case of malignant stricture of the rectum, in which, as a palliative measure, he completely divided the recto-vaginal septum, sphincter ani, and perineum; the operation gave great temporary relief.]

The main object in the treatment is the alleviation of pain; and this is best effected by the use of anodynes exhibited in the shape of suppositories made of pil. saponis comp., or of morphia mixed with extract of hyoscyamus, in the proportion of half a grain of the salt to ten grains of the extract. This should be introduced each night into the rectum, and in the course of time the strength of the anodynes must be increased. I have seen very great relief given to the patient for many weeks by the use of this suppository. As the disease extends, and involves other parts, the suffering is much more severe, and it will be found necessary to give opium by the mouth as well as by the rectum, in order to produce a mitigation of pain. [Dr. D'Arpene, of Elba, has suggested enemata of gastric juice (Med. News and Library, May, 1871, from Lancet, March 18, 1871).]

The bowels are to be unloaded by the occasional use of aperients, and, when there is not much irritation caused, by the exhibition of enemata of warm water. In order to soothe the ulcerated and painful parts, injections of tepid oil or of decoction of poppies must be used from time to time: the surgeon must not forget to take great care in the introduction of the enema-tube, as serious mischief may soon be effected.

During the time the malady is running its course, the strength of the patient, which will gradually decline from day to day, must be supported by those articles of diet which contain the most nourishment in the smallest bulk, and which leave but little feculent matter in the intestines: and it will be needful to avoid as much as possible vegetables and bread. The profuse sanious and foul discharge which sometimes accompanies this disease

may be checked by an injection composed of sulphate of copper and opium, or a very diluted lotion of solution of chloride of zinc may be employed with benefit.

If sudden and complete obstruction of the bowels should occur during the course of this disease, it will be a question as to how far the surgeon is justified in making an artificial anus. If this accident happens in the last stage of the disease, when the patient is much exhausted by previous suffering, I do not think that the operation should be performed; but if the obstruction, which must be fatal, should occur during the earlier course of the affection and before the constitution of the patient has been much impaired, the surgeon is only doing his duty if he recommends a proceeding which, although in itself surrounded with difficulty and danger, may yet prolong life for several months at least, and allow the patient to die at least in comparative ease. Some surgeons were, a few years since, in the habit of performing excision of the lower part of the rectum when affected with cancer, but this proceeding must be looked upon both as barbarous and unscientific, and it is now, happily exploded from the catalogue of surgical operations.

[Since the above statement was made, an entire change has taken place in the opinions of leading surgeons, and excision of the rectum, in suitable cases, ranks among legitimate operative procedures. It has been resorted to, with a satisfactory degree of success in the way of prolonging life and alleviating suffering, by Nussbaum, Hueter, Koeberle, and Volkmann, in Germany; by Polaillon, Verneuil, Marchand, and others in France; by Cripps, T. Holmes, Hutson Ford, and Gay, in England; and by Agnew, Briddon, Levis, J. R. Wood, Willard, Peabody, Otis, and Kelsey, in the United States.

The reader will find an excellent paper on the subject, by Dr. J. B. Roberts, of Philadelphia, in the "Surgery of the Pennsylvania Hospital," 1880; and a number of articles containing reports of cases, with comments, have recently appeared in various American and foreign journals.

Directions for the procedure will be found in the article on OPERATIVE SURGERY, Vol. III.]

POLYPUS OF THE RECTUM.

Polypus of the rectum, although a somewhat rare disease, is not unfrequently seen by those who have large opportunities of studying the affections of this portion of the intestinal canal. It is met with in various forms, and it is important to be acquainted with the disease, inasmuch as it often produces most severe symptoms, and at the same time is easily remedied.

The most simple form in which a polypus is seen is where there are one or more short processes, as it were, of the mucous membrane standing out prominently in the cavity of the rectum. These bodies, if they may be so termed, produce little uneasiness, and are generally only accidentally discovered when the surgeon is making an examination of the bowel with the speculum for some other disease. They are usually situated above the sphincter, cause very little inconvenience, and therefore do not demand the attention of the surgeon.

The soft gelatinous polypus, like that growing from the mucous membrane of the nostril, is very rarely indeed met with; but it is not an infrequent occurrence to observe a polypus which grows from the mucous membrane of the rectum about an inch from the orifice. It varies in length and thickness, being from half an inch to two inches in length, and as thick as a crow-quill or as the little finger. This form of tumor is of a reddish-white color, firm in texture, and attached to the mucous membrane sometimes by two distinct stalks; or it may have only one attachment and a bifurcated extremity. On examination this form of polypus is found to be fibro-cellular in structure, and very slightly vascular. In one specimen of this fibrous polypus, which I lately removed from the mucous membrane of the gut just within the verge of the anus, some curious microscopical appearances were observed. The structure was principally fibrous, but the mucous covering was arranged so as to form a number of very distinct villous processes. It looked like a piece of small intestine; lacteals could be seen in the villous processes, and their trunks could be followed for some distance into the tissue of which the tumor was composed.

When seated high up, this polypus does not produce much uneasiness; but most generally it is attached to the bowel so near to the anus, that when the patient is at the closet the extremity of the tumor protrudes, and perhaps becomes gripped by the sphincter, and in this manner very annoying and painful symptoms are produced. Sometimes even the polypus protrudes when the patient walks about; great irritation exists, there is a discharge of mucus, sometimes of a little blood; and the patient is obliged to wear a support, which gives ease. He is conscious of some foreign body at the anus, but the symptoms are usually attributed to piles.

The only efficient treatment for this kind of polypus is to remove it; and as there is so little vascularity, it may safely be taken away by the scissors, especially when the tumor is very near to the anus; for if there be any hemorrhage it is easy to stop it. When the polypus is situated an inch or more above the anus, and the base is at all broad, the tumor should be well brought down by an injection previously given, and a thread can be tied tightly around the base before the growth is snipped away. In several cases, however, where I have cut these fibrous polypi away without first tying them, there has only been a very slight amount of bleeding subsequently.

Fig. 405.

Warty polypi at the anus.

A form of polypus very rarely met with is where the growth is warty.

I lately saw a gentleman of middle age, who consulted me for prolapsus; and on coming to examine him, after making him protrude the parts well, I found attached to the base of the prolapsed portion, about an inch from the verge of the anus, a curious-looking mass, composed of an aggregation of small lobes arranged upon a peduncle, just like a bunch of grapes. This polypus, if it may be so termed, was an inch in length, of a reddish-white color, and it protruded at the centre of the anus. I removed this growth, and on microscopical examination its texture was chiefly or entirely epithelial; in fact it might be considered as a warty growth.

The *vascular* polypus is, perhaps, of most frequent occurrence; it is chiefly met with in young children. The tumor varies in size from a cherry to a pea; is of a bright red color; its structure is fibro-cellular, and eminently vascular. It is either situated within a short distance of the anus, or it may have its attachment one or two inches up the gut, by means of a long narrow stalk. The symptoms which this form of the disease produces is the prolapse of the tumor on the child evacuating the bowels, and hemorrhage of a more or less profuse character. This bleeding not only takes place when the child is at the closet, but it will persist afterwards, when he is running about. The occurrence of this loss of blood in a child should lead to a close examination of the rectum for polypus; for if the tumor be attached high up, it will recede immediately after the action of the bowels, and escape observation. It is necessary, therefore, to make the inspection immediately after the evacuation of the contents of the rectum either by medicine or an enema.[1]

The treatment which should be adopted is simple, and merely consists in the removal of the polypus, either by twisting it off with a pair of forceps, or placing a

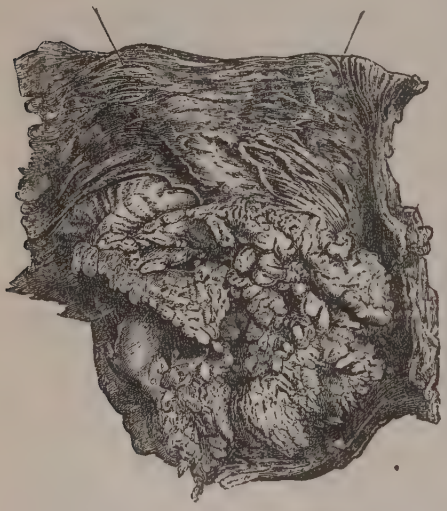
[1] It is very important to make a thorough examination of the rectum immediately after the bowels have been acted upon, when there is a suspicion of a polypus, otherwise the disease may escape notice. A remarkable illustration of this occurred in a lady to whom I was called by a medical practitioner, who had been in constant attendance upon the patient, whose symptoms were referred to some external piles. These were removed, but with scarcely any relief to the severe pain experienced after the action of the bowels, and to the sense of protrusion. I made a careful examination, after the bowels had been well cleared with an enema; but nothing was observable beyond a slight crack at the posterior part of the anus. It was thought right to divide this, in the hope that the severe pain would be removed by the operation, but this failed in its object; and we were vainly endeavoring to ascertain the cause of her suffering, until on one occasion we found the patient had just got into bed after having had the bowels freely acted upon. I took the opportunity of examining her immediately, and to my great surprise found a large fleshy polypus attached high up to the posterior wall of the gut by a narrow peduncle. Without further delay, I, with some difficulty, placed a double ligature around this tumor, and thus fortunately removed a disease which, from being long undetected, had caused great suffering. It was strange that this polypus had not shown itself when I examined her on a previous occasion, after the action of the enema.

ligature around the pedicle, and returning the tumor within the bowel and allowing it to slough off. Excision should not be resorted to in these cases, as there might be a considerable amount of bleeding, which would be especially prejudicial in a young child.

A rare form of polypus of the rectum is occasionally met with in adults, when the tumor reaches a size as large as an egg; it has been not inaptly termed the *villous* tumor, inasmuch as it mainly consists of elongated processes or villi, extremely vascular. This form of tumor produces most severe symptoms of a foreign body in the bowel, and is the cause of periodical hemorrhage to a large extent, by which the health becomes very much broken down. It is a question with some as to whether this form of polypus is malignant or not.

Mr. Quain has made some investigations into the structure of this tumor, and he has found that it was composed of long

Fig. 406.



Villous tumor of the rectum. From a preparation in the Museum of St. George's Hospital.

processes slightly held together, each process strictly resembling villi. And as the mass is very vascular, he has concluded that the disease is not of a malignant nature, as stated by Rokitansky.

A very interesting specimen of this rare form of tumor of the rectum is preserved in the Museum of St. George's Hospital, and on examination it presents exactly the features described by Mr. Quain. It was situated about three inches from the verge of the anus, in the anterior wall of the rectum, evidently springing from the submucous cellular tissue. It is round in form, circumscribed and prominent, and about the size of an orange. The tufts or processes are remarkably well developed. The tumor so obstructed the cavity of the bowel, that almost complete retention of the feces resulted, and the gut above was very much distended. The bladder was much pressed upon by the diseased mass. It was impossible to say how long the disease had been growing, but it was not detected until about five years before death, when the occurrence of hemorrhage and of the symptoms before spoken of led to its discovery. Several attempts were made to destroy the mass by ligature and other means, but it was not possible to effect more than a partial removal of the more prominent portions—an operation which was performed no less than thirty-three times before his death, and on each occasion with temporary benefit. The patient was seventy when he died, and no other disease was found on a careful examination of the body.[1]

I have only once met with an instance of a growth of this nature, but it was of a very interesting character, inasmuch as it had resisted treatment and had reduced the patient to a very low state. It was that of a married lady, sent to me by Dr. Rooke, of Cheltenham. She had suffered much from profuse hemorrhage from the bowel without any protrusion whatever, and when I first saw her it was extremely difficult to ascertain where the bleeding came from; but after a very careful examination with the speculum, I found a well-defined vascular growth, about the size of a crown piece, two inches from the anus. From the condition of the patient, and the appearance of the diseased parts, I was afraid that it might be of a malignant character, and this idea was somewhat confirmed by the continuance of the bleeding, notwithstanding very careful local and general treatment. However, finding milder measures fail, I determined to apply with vigor strong nitric acid to the part. This I did on several occasions, and was much pleased to find that the bleeding became checked, and after about half a dozen applications the hemorrhage ceased, and the patient's health was rapidly restored. I saw this lady lately, some three years after the treatment, and she was in remarkably good health.

Pruritus Ani.

This affection is very common, and very productive of suffering; and although certain pathological changes occur at the margin of the anus in connection with it, itching and irritation of this part must be regarded rather as a symptom than as a special disorder. Thus it is frequently associated with an unhealthy state of the secretions of the intestinal canal, or with simple constipation—a fact which is not uncommonly overlooked in the treatment of those who suffer; it is also attendant upon a congested state of the vessels of

[1] Path. Soc. Trans., xii., 120.

the rectum, which can hardly be considered hemorrhoidal, inasmuch as on examination there will be found neither hemorrhoidal tumors nor prolapsus, but a considerable amount of congestion of the mucous membrane. This form of the complaint is peculiarly prone to occur in those who sit for a long time together at the desk. Pruritus is familiar to us as a symptom of ascarides in the rectum; it is also found in a very distressing degree in connection with disordered conditions of the womb. I have recently seen a case of ulcer of the rectum, where the only well-marked symptom attending upon this usually painful morbid condition was a constant and troublesome itching.

Certain morbid changes occur around the margin of the anus in advanced cases of this disorder, in consequence of the attempts of the patients to relieve themselves by scratching and irritating the parts; the naturally thin skin becomes excoriated; the secretions of the part are exaggerated; and if the irritation is continued, fissures, and even ulcerations, are formed; and in course of time the integument becomes thickened and indurated, and gets almost into a condylomatous state; and a painful and distressing itching is produced—especially when the patient lies down in bed—which is most troublesome to remove.

[A very common cause of anal irritation is the incomplete emptying of the bowel, and the consequent presence of a portion of feces pressing against the internal sphincter. The injection of a small quantity of cool water will bring away the irritating mass, and relieve the itching.]

The treatment to be adopted in such cases is to be conducted upon the ordinary principles of surgery. In the first place a very careful examination of the parts must be instituted, both external and internal; and strict inquiry should be made with a view of ascertaining if there be any special cause for the existence of the pruritus, such as ascarides or a loaded state of the large intestines; in either case the exhibition of purgatives and the use of enemata will be the proper plan of treatment, and immediate relief ensues. If dyspepsia, together with an unhealthy secretion, exist, strict avoidance of improper articles of diet, and the occasional use of a pill composed of a grain of calomel and three or four of watery extract of aloes, will frequently remove the itching of the anus, without the employment of any local measure beyond the application of water or soap and water. It is, however, in those cases where the disease, although perhaps at first only a symptom, has, by neglect and irritation, degenerated more decidedly into a local malady, that great difficulty is experienced in procuring relief. Here, at the same time that constitutional measures are not neglected, local remedies will be mostly required; but very often many will be tried, one after the other, before the desired relief can be obtained. In these cases there will be generally found some morbid alteration, in the form of slight ulcerations or fissures of the skin, and the first object is to heal these; and it may be effected by the very careful application of a solution of nitrate of silver—of a strength varying from ten to twenty grains of the salt to an ounce of water—by means of a camel's-hair brush. The application should be repeated so long as the cracks or ulcerations exist. Not unfrequently the itching and irritation will disappear so soon as these heal and the skin becomes healthy; but there is a tendency for the excoriations to reappear; and to prevent this, the patient should be advised to bathe the parts well morning and night with a strong solution of alum. If the solution of nitrate of silver fails either to heal the fissures, or to give relief to the itching when they are healed, an ointment composed of one drachm of glycerine to an ounce of lard may be used with good effect; and should there exist a thickened or condylomatous condition of the integument, I know of nothing more useful than the application of an ointment composed of one drachm of calomel and one ounce of lard. If an ulcer—as in the case mentioned before by me—should be found to exist within or upon the sphincter, the ordinary operation for that malady must be put in force.

[Sometimes an ointment containing camphor ʒss, chloral ʒss, to ℥ss of ung. petrolei, will give relief; or one of ʒj of ext. stramonii to ʒiij cer. plumbi subac., or a suppository with extract of opium. Certain washes may also be used with success; such as lead-water; water slightly impregnated with carbolic acid, or rendered alkaline by the carbonate of soda Again, in some cases it is better to keep the skin as dry as possible, even using powdered lycopodium, rye-meal, or ordinary infant's powder, for the purpose.]

In some obstinate cases, it will be found that the use of all the usual measures, general and local, will be unattended with relief. If it has not already been tried, I am in the habit of recommending the daily introduction of a well-oiled bougie made of black wax.

Neuralgia of the Rectum.

It is perhaps impossible to affirm with truth that neuralgia, as it attacks other parts of the body, is ever situated in the rectum; but every now and then cases are

met with where extreme suffering of a distinctly neuralgic character is experienced for a long period, and where, on the most careful examination of the parts, both external and internal, no appreciable lesion can be found; and we therefore do not hesitate to apply the term neuralgia to this condition of things. The cases are more frequently met with in the persons of females who have been lowered by some depressing causes; the pain is described as being very severe and continuous, and not particularly aggravated by the action of the bowels, as is the case when the suffering is produced by a painful ulcer of the rectum. It may be of a marked periodical character, and be the result of direct exposure to cold.

The cure of this affection is extremely difficult, and indeed sometimes only a temporary relief can be given. Of course, when a patient applies with the symptoms of neuralgia, the most careful examination of the parts should be instituted, and repeated from time to time; for doubtless in some of those cases which have been supposed to be neuralgia, there has been some lesion which has been overlooked. If, however, nothing of the kind can be met with, a similar treatment to that which is put in force for neuralgia in other parts should be adopted, due regard of course being had to the removal of any local irritant from the bowels in the shape of hardened feces: iron and quinine in large doses should be exhibited, especially in those cases where there has been any lowering of the system; should there be any tendency to gout—a point not to be overlooked in our inquiries—colchicum should be prescribed. The local remedies best suited for this complaint are, the employment of the cold douche to the anus, and the use of belladonna ointment, in the proportion of one drachm of the extract to one ounce of lard, either smeared around the anus, or introduced up the rectum by means of a large wax bougie. Should the latter measure be adopted, care should be taken to watch the effects of the belladonna on the system.

HERNIA.

By John Birkett, Esq.

Revised by John H. Packard, M.D.

PART I.

Pathology and Treatment of Hernia in General.

An escape of any viscus from the cavity in which it is naturally placed is termed a hernia; but the observations in this essay are exclusively restricted to protrusions of the abdominal viscera. In common language this disease is called rupture. Our object will therefore be to describe the varieties of hernia developed in the different regions of the abdomen, their pathology and treatment.

The whole subject is divided into two parts.

The first embraces general considerations in relation to the statistics, pathology, and treatment of the disease.

The second is devoted to an examination of the special regional varieties of hernia, their anatomical characteristics, etiology, diagnosis, prognosis, and the treatment especially adapted to each kind.

Sex.—Both sexes are afflicted with hernial protrusions. After carefully considering the statements of writers in relation to the numerical proportion in which the two sexes are subject to hernia, we must admit that we have not the requisite data to enable us to arrive at any satisfactory conclusion. We may, however, broadly state the fact, that hernia occurs more frequently in males than in females. Out of a gross total of 96,886 applicants for trusses at the City of London Truss Society, the males were 78,394, the females 18,492. After a careful consideration of all the circumstances, Mr. Kingdon estimates the proportion at two males to one female, for all ages and including every variety of hernia.[1]

[1] The proportion between males and females varies considerably at different periods of life, on account of causes connected with certain congenital malformations, which will be

[In the Am. Journ. of the Med. Sciences, for October, 1873, may be found a notice of a paper by Mr. John Croft, published in St. Thomas's Hospital Reports, vol. iii., containing the statistics of 2401 cases of hernia, derived from the records of the National Truss Society for seven years. Of this number of patients, 1990 were males, and 411 females; the former being therefore nearly five times as many as the latter. Mr. Croft is quoted as of opinion that the true proportion is something over three to one.]

Frequency of hernia at different ages.—The only trustworthy facts relating to the various ages at which hernial protrusions are first developed, have been collected by Mr. Kingdon. In the reports of the City of London Truss Society for the years 1860 and 1861, he has tabulated 9,296 cases of inguinal and femoral hernia. All these patients passed under his personal examination, and the respective age of each individual when the hernia developed itself was ascertained as accurately as possible, by reckoning back to the age at which it was first noticed. Observers have been before this occupied in attempts to ascertain the ages when protrusions most frequently occur; but they have uniformly noted the ages of the persons at the time of their appearance before them. Accurate data were, under these conditions, never obtained; that is, if a knowledge of the age at which hernia is developed is to be regarded as a desideratum. Hence M. Malgaigne makes it appear that there are fewer cases of hernia before thirty-five years of age than after. This is a fundamental error, unless national peculiarities produce different results. The truth is, taking all varieties of hernia in both sexes, that the majority of cases are developed before thirty-five years of age.[1] I believe in the correctness of this fact, after having tested its accuracy as far as my means allow. It is, I know, directly in opposition to the received dogmas; but as we advance we shall be able to assign very good reasons why hernia is so much more common before middle life than after that period.

[The reviewer before quoted says: "As regards age, 1355 of the 2401 patients were under, and 1046 over thirty-five years of age; but by comparing these figures with those of the *total population* of London at each age, it is found that hernia is proportionately more frequent after than before middle age. The first quinquennium of life is, however, that in which hernia is most apt to occur, no less than 472 of Mr. Croft's cases having been in children under five years of age."]

Frequency of hernia in relation to population.—We have no trustworthy data on this subject. The general statements which have been advanced, in some of which the proportion is put as high as one in eight of the male inhabitants of the whole kingdom, and even one in five of the whole population of one district, do not rest on any precise information, and appear exaggerated.

Frequency of hernia in relation to age.—Mr. Kingdon's statistics (Table A) show that out of 9296 applicants for trusses, 1516 were under five years of age. This would appear at first sight to show a much greater prevalence of hernia in infancy than during any other period of life. But this disproportion vanishes when we take into consideration the number of infants out of any given population. Thus, if we take Mr. Kingdon's table as giving an accurate idea of the numerical prevalence of hernia at different ages in London, we must compare the ratio between the number of cases of hernia at any given age and the total number of cases of hernia, with the ratio between the number of the population living at that age and the total population. Proceeding in this manner, we shall find that while there is no exact proportion maintained, yet the frequency of hernia slightly advances towards the latter end of life. Thus, taking the census of 1851, the total population of London of both sexes at all ages was 2,362,236; out of these, 293,562 were

spoken of in treating of the special forms of hernia. Thus, in Mr. Kingdon's statistics for 1860 and 1861, there were in the first five years of life 1409 males, and only 107 females; while in the five years from 25 to 30 years of age, the proportion had changed to 846 males against 207 females.

[1] The following statements show the number of cases of hernia occurring at different ages, when the age of each patient was recorded by M. Malgaigne, at the time each one came under his observation; and when the respective ages were carefully ascertained by Mr. Kingdon, to show when the hernia was first noticed. Out of 2343 cases recorded by M. Malgaigne (L'Union médicale, 1854, p. 53), 555, or 23.6 per cent., were under 35 years of age; 1788, or 76.4 per cent., above that age. On the contrary, out of 9296 cases recorded by Mr. Kingdon, 5659, or 60.8 per cent., had commenced before 35 years of age; and 3637, or 39.2 per cent., after that age.

As the two tables exhibit such different results, I wrote to M. Malgaigne, who kindly returned the following polite reply:—

"Mon cher confrère—La réponse à votre question: les âges marqués à la page 53 (de L'Union méd., vol. viii., 1854) sont ceux des malades au moment où ils venaient à la visite du bureau central."

TABLE A.—*Showing the ages of the patients when the hernia was first noticed.*

Age.	1860.				1861.				Kingdon's Tables—Report of Truss Society, 1861–62. Age at development.	
	Inguinal.		Femoral.		Inguinal.		Femoral.			
	M.	F.	M.	F.	M.	F.	M.	F.		
under 1 year	473	27	...	...	563	37	...	...	1100	
1 to 5 years	181	17	...	...	192	26	...	...	416	1764
6 " 10 "	91	23	3	1	112	16	2	...	248	
11 " 15 "	115	19	4	2	133	19	3	6	301	981
16 " 20 "	284	27	3	14	291	38	8	15	680	
21 " 25 "	348	30	18	31	375	33	13	37	885	1938
26 " 30 "	381	45	21	58	424	50	20	54	1053	
31 " 35 "	334	48	19	55	399	37	14	70	976	1909
36 " 40 "	320	38	18	59	373	41	16	68	933	
41 " 45 "	271	31	30	47	268	24	11	49	731	1377
46 " 50 "	258	11	18	32	272	10	15	30	646	
51 " 55 "	167	12	12	26	224	11	11	27	490	846
56 " 60 "	147	6	9	16	151	4	8	15	356	
61 " 65 "	97	6	10	11	110	3	7	12	256	379
66 " 70 "	59	5	8	2	44	1	1	3	123	
71 " 95 "	32	1	1	1	54	3	3	7	102	
	3558	346	174	355	3985	353	132	393	9296	

under 5 years of age: a ratio of 1 to 8.004. Out of the 9296 which form Mr. Kingdon's total, 1516 were under 5 years of age,—a ratio of 1 to 6.13. Taking the next decade, we find the total number of the population between 5 and 10 to be 243,648, or in a ratio of 1 to 9.69 to the total population; the number of cases of hernia, however, is only 248, or in the ratio of 1 to 37.08 to the total number of cases of hernia. Again, it was shown above that the absolute number of cases of hernia developed under 35 years of age was greater than that of those developed above that age, the proportion in Mr. Kingdon's table being 61 to 39. But in the census table the proportion of persons alive under 35 to those above that age is still higher, viz., 69 to 31. Therefore hernia is more common relatively to the number of the population above the age of 35 than under that age. It appears from calculation on these data, that 41 per cent. of cases of hernia are developed under the age of 35, and 59 per cent. over it.

The relative proportions of the different kinds of hernia at various ages and in both sexes, together with explanations of their occurrence, based upon anatomical and physiological facts, will be found in other parts of this essay.

The influence of occupations on the formation of hernia.—All persons, in every station of life, are liable to hernia. By far the majority of cases occur among the laboring class, which, abounding as it does in all large towns, affords a favorable opportunity to ascertain whether the pursuit of any particular trade or occupation involves a greater liability to hernia than another.

Mr. Kingdon has inquired into this subject with his usual care, and the results of the investigation are printed in the Report of the City of London Truss Society.[1] He has produced a table in order to compare the twenty-five largest classes of occupation, arranged in the order of their magnitude from the census of 1851, with the numbers of each class who applied to the Society during three successive years. This "indicates that the patients who seek relief on account of hernia bear a direct proportion to the numerical magnitude of the classes to which they respectively belong, and not to the severity of the toil."

The influence of hereditary confirmation predisposing to the development of hernia.—A disposition to hernia may be inherited; that is, the children of ruptured parents are frequently afflicted in like manner. Mr. Kingdon has taken great pains to ascertain the proportion of cases in which this hereditary influence exists. In the reports of the City of London Truss Society for 1860–61, he has published the result of his inquiries. Both sexes show an equal tendency to be thus influenced. The proportion, by calculation, seems to be about 34 per cent. This hereditary predisposition, paternal, maternal, or on both sides, is manifested in the most

[1] Report, 1861, p. 11.

marked degree with infants under one year; the cases being about 12 per cent. of the whole number in the first twelve months of life.

This fact points to two very important causes which give rise to hernial protrusions at this early age: first, to the arrested efforts of nature in closing the ventral orifice of the vaginal process of the peritoneum, and the obliteration of that sheath: and, secondly, to an abnormal elongation of the mesentery. Those two structural conditions belong to a class of anomalies very likely to be determined by hereditary influences.

Congenital defects of the parietes of the abdomen have been already mentioned as predisposing causes of hernia, and this subject will be further dwelt upon in discussing its various forms. Wounds, inflammatory lesions of the abdominal walls, and other predisposing causes may be mentioned. It is a question, whether a portion of small intestine can reach the fundus of the scrotum, unless its mesenteric ligament be of preternatural length. For it is difficult to understand how the upper portion of the intestine or the cæcum can descend so low as they are sometimes seen, without at the same time their mesenteric folds being elongated. But the fact to be accurately ascertained is, whether the mesentery is abnormally long antecedent to the descent of the hernia; whether, in truth, a morbid elongation of the mesentery be a primary cause of hernia or not. Doubtless this structure becomes lengthened and stretched as the result of repeated or continued descents of the intestine; but we are not cognizant of any facts to prove a congenital condition of the kind above alluded to. At first sight, this circumstance regarding the elongation of the mesentery may seem to have very slight practical value. Upon reflection, however, we shall arrive at an opposite conclusion. It has a very important bearing on the question of the radical cure of hernia, as it is termed. For if it be proved that the primary cause of any viscus protruding from the abdominal cavity can be traced to a morbid condition of its peritoneal retaining ligaments, the mere obliteration of the hernial sac can avail but little in producing the intended result of affording permanent immunity from the disease. That which often happens when a truss is used to support one kind of hernia would occur in this case also, namely, the development of another, perhaps even on the opposite side of the body; and thus any operation, even if successful in obliterating the first sac, would be of little value.

Persons in whom a hernial sac exists certainly state that they are more troubled with the descent of a hernia if they get out of health. This circumstance leads to the inference, that when the tissues generally are weakened and relaxed by indisposition, those which should maintain the viscus in its proper situation, participate in the general morbid condition, and then permit the hernia to escape more readily.

It is equally certain, too, that persons constitutionally of a weak frame of body, whose contractile and fibrous tissues are deficient in tone and power, become more commonly subject to the development of a hernial sac as age advances, than those of an opposite conformation; always, of course, excepting those persons who have a congenitally open vaginal process of the peritoneum.

And further we may state, as the result of actual observation, that in both males and females of middle age, the subjects of hernia, the heavy abdominal viscera, the solid glands for example, are usually disposed in a much lower situation than their normal one; that, in fact, the abdominal viscera generally are not so firmly held in their proper places by their peritoneal ligaments as when no disposition to hernia is shown.

Between the muscular walls of the abdomen and the contents of that cavity a constant antagonism exists. The gaseous and fluid distension of the intestinal tube exerts an ever variable pressure against the abdominal walls, whilst they, in their turn, react upon the inflated viscera; thus between these opposing forces a sort of equilibrium is maintained. The balance between them is, however, sometimes destroyed, and the parietes are no longer able to restrain the viscera within their normal limits. Thus hernia is often associated with a great increase in the bulk of the viscera, from the rapid development of fat in the omentum and mesentery. A persistent laxity of the parietal peritoneum likewise, subsequent to distension of that membrane, occasioned by the gravid uterus, is a morbid condition which renders it liable to pass readily out of the abdomen, under the influence of any pressure from within, through the weak points of the walls, and it must also be reckoned among the predisposing causes of hernia.

[It is not uncommon to meet with cases in which the tendinous structures of the abdominal wall are composed of very loosely connected fibres, and the natural openings are unusually wide; the muscular bundles may also be lax, and readily separated from one another. Perhaps a better way to state the fact would be to say that bodies vary much in the degree of firmness and closeness of these textures. Not only in the dissecting-room,

but in practice, and especially in cases of hernia, these variations may be noted.]

The immediate cause of a hernia is certainly, in some cases, to be traced to a sudden and forcible diminution in the capacity of the abdominal cavity, the result of compression or contraction of its walls; in other words, the combined actions of the abdominal muscles, coincident with strained attitudes and postures of the body during the effort of violent muscular exertion generally, give rise to the sudden development of a hernia. We cannot, perhaps, accept as truth the statement of all the ruptured men who attribute their affliction to muscular exertion; but all surgeons who have had much hospital experience will be able to call to mind cases depending upon this cause.

A large proportion of the cases of hernia are undoubtedly of gradual development. In many of these, however, violent muscular contraction doubtless plays an active part. How often we observe hernial tumors in patients afflicted with dysuria! Is not hernia very liable to occur in persons laboring under bronchitis of one form or another? And although it must be admitted that more or less laxity and loss of restraining power in the tissues of these persons exist with regard both to the fibrous walls of the abdomen and the peritoneal ligaments of the viscera, yet this effective agent, muscular contraction, exerts its powers with less restraint and limit, and thus presses the viscera away from their normal situation.

The hernia consists of a part only of any of the abdominal viscera. Such of them as are permitted, by their peritoneal attachments, to change their relative situation within the abdominal cavity with the greatest freedom, most frequently escape or protrude through its walls. Thus portions of the small intestines and omentum form the contents of the hernial sac in the majority of cases, although a part of every abdominal viscus has been occasionally found therein.

Semiology.—The signs which denote a rupture are more or less marked according to its volume, its condition, the viscus composing it, and the thickness of the tissues by which it is covered. The patient complains of "a weakness" in the region in which a hernia commonly occurs; and this is often the first symptom which indicates a tendency to a protrusion in the adult. The inguinal region, especially in a male adult who makes a complaint of this kind, shows a remarkable fulness at the site of the internal abdominal ring, and often along the whole track of the region of the abdominal walls termed the inguinal canal, if carefully examined. From a similar appearance, a tendency to hernia may be detected in the weakly and delicate adult female at the crural aperture. In both cases the fulness becomes much more distinct if the patient maintains the erect posture and forcibly contracts the abdominal muscles.

Next, a small swelling or "lump" is felt, which is not permanent, but disappears under slight pressure or on assuming the recumbent posture. It reappears when the pressure is removed or on standing erect, and it becomes more prominent when the abdominal muscles are put into strong action by coughing or some voluntary effort.

In infants and children the tumor produced by a hernia is often of considerable size when noticed for the first time; but it soon diminishes if the swelling be pressed, or the recumbent posture imposed. In youthful adults also a hernia is often developed suddenly, generally in the inguinal region or scrotum. This, happening under the influence of violent muscular exertion or forcible compression of the abdominal walls, is usually attended with more or less pain.[1]

The structure of the viscus which forms the hernia also modifies its signs and indications: thus, if the protrusion be solid, as when omentum escapes (epiplocele), the hernial swelling will be hard, resisting, and lobulated; if the protrusion be hollow, as in hernia of intestine (enterocele), the swelling will be yielding, soft, elastic; and if the contents be gaseous and fluid, it will yield a dull sound on gentle percussion, or a peculiar gurgling is heard at the time the rupture is handled.

Some swellings formed in those regions where hernial protrusions commonly occur closely resemble that disease; but as they are liable to simulate some special kind of hernia, their differential diagnosis is given in other parts of this essay.

Prognosis.—By ordinary care and precaution, a person the subject of hernia is not in great danger of those accidents affecting it which imperil life. On the contrary, however, by neglecting to employ a bandage to prevent the escape of the hernia, or by making use of an instrument which fails to effect the purpose intended, namely, the complete retention of the hernia within the abdomen, the life of the individual is perpetually in jeopardy from the liability to inflammation or strangulation of the protruded viscus.

In proportion, then, as the palliative

[1] In a manuscript lent to me by Mr. Kingdon, he shows that, out of 706 adult males, only 48 pretended to assign any cause for the protrusion; but I find that the majority of the men in whom the inguinal hernia was suddenly developed were youthful adults.

measures directed by the surgeon are carefully employed by the patient, the prognosis in any case of reducible hernia may be regarded as favorable, or the converse.

If the hernia be a small reducible enterocele, a truss may be used, which will prevent its descent for months, or even years. If the case be one of irreducible epiplocele, complicated with the occasional descent of small intestine, the prognosis must be regarded as relatively unfavorable, in consequence of the great difficulty in preventing the entrance of the bowel at the orifice of the sac, where it may become strangulated without any premonitory symptoms.

Nomenclature of herniæ.—The varieties of abdominal herniæ are named from the period of life at which the hernial sac is formed; the region in which the protrusion takes place or exists; as well as from the viscus which composes the tumor.

When named from the viscus forming the protrusion, a hernia is styled intestinal when any portion of the alimentary canal escapes. This is also termed an enterocele.

If a portion of omentum protrude, the expression omental hernia, or epiplocele, signifies its nature.

A combination of these two is called an entero-epiplocele.

The terms gastrocele, cystocele, have been applied to protrusions of the stomach or bladder from the abdomen.

The classification of hernia according to the regions in which it occurs is given in the second part of this essay.

The essential parts of a hernial tumor.—When an anatomist dissects a tumor caused by the protrusion or escape of any viscus from the cavity or region in which it is naturally contained, his observation should be especially directed to three principal objects. These are:—

1. *The tissues outside the sac*, or the ordinary structures of the region in which the hernia is developed;
2. *The sac;* containing
3. *The hernia* itself, or the protruded viscera.

Under these three sections we shall describe the essential elements of a hernial tumor: first, in the condition in which they commonly exist, when the only source of trouble depends upon the mere tendency to the protrusion of the hernia; and, secondly, under those morbid conditions which affect certain parts of the sac; the contents of the sac, the real hernia; and the tissues outside the sac. Upon the judicious surgical treatment of these morbid conditions the salvation of life depends.

The inciting causes of hernia.—Protrusion of the abdominal viscera are the result of—

1. Wounds or lacerations of the abdominal walls;
2. The weakening or destruction of the same parts by inflammatory processes;
3. The existence at birth, and persistence afterwards, of a canal which is a prolongation of the peritoneum; and,
4. The gradual expulsion of the parietal peritoneal membrane at weak parts of the abdominal walls, forming a pouch or receptacle for portions of the viscera.

1. In this essay I am not required to describe those of the first class, which depend on wounds, such cases having been treated of under the head of INJURIES OF THE ABDOMEN.

Hernia, however, occasionally occurs in the inguinal region, as the result of the application of direct violence in its vicinity, without any wound of the integuments.

2. *The weakening or destruction of the abdominal parietes* from the effects of inflammation and its results give rise to the secondary occurrence of hernia. Thus, after the healing of abscesses in those parts, it is not very uncommon to see a hernial tumor developed at the site of the primary disease. It is important, therefore, as a prophylactic measure, to support the abdominal region by means of a suitable bandage during the healing of such abscesses, and for some time after cicatrization.

3. *Congenital patency of the vaginal process of the peritoneum.*—We must now consider that congenital condition of the peritoneum which allows a portion of the abdominal viscera to escape from its natural cavity and occupy an abnormal position in its immediate vicinity.

Towards the close of the last century, and at the commencement of this one, anatomists were very much interested in observing the changes in the situation of the testicles during the period of fœtal life. Accurate observation established the fact, that the development of the testicles commenced in the lumbar regions of the fœtus in utero, and that when those organs had reached a certain stage of perfection, they migrated from their primary locality, and, pursuing a course towards the pelvis, they at last reached the scrotum, the final point of their destination. In this progress, termed the "descent of the testicles," and whilst they are within the abdomen, they are placed behind the peritoneum, and partially invested by it. A prolongation from

this serous membrane accompanies them into the scrotum, and receives the name of the vaginal process of the peritoneum.

Thus wrote Wrisberg in the year 1800: "Testis semel in scrotum delapsus pluribus cingitur velamentis. Tria esse membranarum genera, quæ id præstant, Tunica vaginalis communis pro teste, epididymide et funiculo spermatico simul; Tunica vaginalis propria vasorum spermaticorum; et Tunica vaginalis similiter testi et epididymidi propria; cuilibet in arte anatomica tironi nunc cognitum est."[1]

A direct and uninterrupted communication exists between the cavity of the peritoneum and the interior of this sheath; so perfect, indeed, that the more movable abdominal viscera can pass, without impediment, from the one into the other. The line of demarcation between these cavities corresponds to, or is in relation with, that arrangement of the internal abdominal fascia termed the internal inguinal ring; and, adherent to the posterior surface of the vaginal process, near its inferior termination, is placed the testicle.

In early fœtal life, and, in many instances, for a month or even a longer period after birth, this tubular process of the peritoneum extends into the scrotum. It lies in front of the spermatic cord and testicle; extends from the internal inguinal ring to the lowest end of that gland; and forms a membranous, cylindrical canal until it reaches the testis, when it expands into an elliptical cul-de-sac. Before birth, or soon after, this vaginal process of the peritoneum is divided into two portions—a superior and inferior. The sheath contracts near the head of the epididymis, its surfaces adhere firmly at that spot, and thus two cavities are formed. The inferior one is termed the tunica vaginalis propria testis: for it is in immediate relation with a large portion of the surface of the testicle. The superior canal, termed the tunica vaginalis propria funiculi, lies in front of the spermatic cord.

When these parts are in a normal condition, the inferior cavity or vaginal covering peculiar to the testis remains throughout life as a closed serous sac, and contains a little serum. Under similar conditions the superior canal or vaginal covering peculiar to the spermatic cord is entirely obliterated. Its superior abdominal or ventral orifice is permanently closed; and although a trace of the existence of this canal is sometimes observable in adult life, it is merely a delicate fibrous cord, the ruinæ processus vaginalis peritonei. Occasionally, although very rarely, a fine membranous canal remains throughout a long life sufficiently large to admit an ordinary-sized probe. In the account of the post-mortem examination of Sir Astley Cooper, it is stated that "a minute serous canal, not more than a line in breadth when opened, was traced, extending from" a depression at the right internal abdominal ring "along the spermatic cord, into the cavity of the tunica vaginalis."[1]

Sir Astley Cooper himself writes: "I dissected a boy, six years of age, in whom the opening of the tunica vaginalis (vaginal process of the peritoneum) was still so large that I could pass a female catheter through it down to the testis." And further on, in the same chapter, he relates a case of "sudden descent of a hernia into a congenital vaginal process of the peritoneum, of the nature above described, in the person of a young man whilst in the act of lifting a sugar-cask."[2] Several instances of a similar kind have come under the observation of the author of this essay.

Of the changes which take place in the vaginal process of the peritoneum.—Several distinguished anatomists have traced the changes which occur in this serous sheath to render its obliteration perfect. Without producing a literal translation of the writings of Seiler, I believe it will be interesting as well as useful to the reader to quote the substance of his observations.[3]

When the testis has reached the bottom of the scrotum, the inguinal canal, along which the cord passes, is still very short, scarcely one and a half to two lines long. In the fourth and fifth month the internal inguinal ring lies almost directly behind the external. The inguinal canal is developed in the later months, and soon after birth it is always longer. The spermatic cord now consists of the bloodvessels, vas deferens, nerves, and the vaginal canal, at the termination of which lies the testis and the larger part of the epididymis.

After the testicle has reached the fundus of the scrotum, the obliteration of the vaginal canal proceeds from the inguinal rings downwards to the superior border of the testis, so that only the proper vag-

[1] H. A. Wrisbergii, Commentationum Med., etc., Soc. Reg. Scient. Gættingensi oblatarum et editarum, vol. i., p. 179, § 5.

[1] Guy's Hosp. Reports, 1841, vol. vi., p. 232.

[2] The Anat. and Surg. Treatment of Abdom. Hernia, 2d edit., chap. xvii.

[3] Anton Scarpa's Neue Abhandlungen ü. d. Schenkel- u. Mittelfleischbrüche, etc., bearbeitet mit einer Anleitung zu der Zergliederung d. Leistengegend, etc. Kupfertafeln von B. W. Seiler, vol. ii., p. 374, etc. Leipzig, 1822.

inal membrane of the testis remains, as a rudiment of the vaginal canal—the tunica vaginalis propria testis. The time at which the closure of its ventral orifice takes place and the obliteration of the canal is completed cannot be well defined. It is usually closed, at least on one side, and generally at the upper part, from the internal inguinal ring to the centre or middle of the spermatic cord, even before the whole vaginal canal has contracted, especially that portion which is embraced by the internal inguinal ring. The first stage of the obliteration of this canal commences with this process.

In the second stage, the walls of the vaginal sheath unite together entirely, as far as the superior end of the testis; or it first closes in the neighborhood of the testis, so that the centre part still remains open.

The third stage is accomplished when the canal is partially or entirely closed. This portion of serous membrane is converted into a flat band, which afterwards becomes connective tissue, but which is rather closer and finer than the rest of the same tissue of the spermatic cord.

As the fourth stage, this stripe of connective tissue always becomes thinner, and at last entirely disappears; or there remains behind only a slight trace of it below, above, or in the centre.

State of the vaginal process of the peritoneum at birth.—In the majority of new-born infants some portion of the vaginal canal still remains. In 21 Seiler found 4 in which it was open on both sides; 5 in which it was open on the right side; 4 on the left; and of these 13, 5 in which the abdominal aperture continued open on either one side or the other. In 5 of the 21 infants the canal was closed above and below, but in the centre open; in 3 the inferior part was closed, but in the upper part, from the internal abdominal ring, a portion remained wide open. Likewise, in other examinations, he found the inferior part unclosed towards the middle of the spermatic cord, or even as far as the internal abdominal ring; more rarely the centre was open, and still more rarely the upper part only.

Camper found, in 53 new-born infants, 23 in which the canal was not closed on both sides; 11 in which it was open on the right side; 6 on the left.

Schreger found the following relations: in 13 new-born infants, the canal was open on both sides in 8; in 6 in its centre part between the abdominal orifice and the testis; in two in its whole length, in which also the abdominal orifice of the right side still remained open. In the remaining 5 it was open between the abdominal fold and the testis, but only on the right side.

Paletta states that, as a rule, the complete closure of the vaginal canal takes place between the twentieth and the thirtieth day after birth.

I have myself dissected numerous fœtuses of full age, and have been surprised to find in what a large majority of them this canal continued patulous either on one side or both sides.

With a knowledge of these anatomical facts, we can readily understand how it happens that a canal or receptacle exists at birth into which a portion of the intestines may enter. When this takes place, the hernia of infancy exists. It is a circumstance of very common occurrence to see an infant soon after birth with an enlargement of the scrotum, which varies in size, and sometimes disappears altogether. It attains its largest dimensions when the infant exerts its abdominal muscles; it slowly decreases and is lost sight of during repose in the recumbent posture or in sleep. This tumor of the scrotum is due to a hernia of small intestine which escapes from the abdominal cavity into the prolongation from the great serous peritoneal membrane, known by the name of the vaginal process of the peritoneum. This serous sheath, which from its structure, allows of considerable distension, is thus converted into a hernial sac. The attention of pathologists was first drawn to this fact by Haller in 1749. His observations were confirmed, and the nature of the disease was still further elucidated, by John Hunter and Percival Pott. Haller employed the term hernia congenita to express that variety in which the intestine and the testis touch each other, or are contained in the same sac; and by this name the disease has been distinguished since the date of his publication. It is, however, a most inappropriate term, inasmuch as the hernia does not exist either during intra-uterine life or at birth. A congenital imperfection, it is true, allows the descent of a hernia soon after birth; and therefore M. Malgaigne calls it the "hernia of infancy." But even this term is not sufficiently definite. I prefer the designation, hernia into the vaginal process of the peritoneum.

4. *Of the slow and gradual development of the hernial sac.*—The peritoneal membrane is capable of very great but gradual extension. This capacity is illustrated by cases of serous dropsies and of ovarian growths. In the same manner as the whole membrane yields to the general pressure of accumulating fluid, so it dilates under the influence of local pressure into a diverticulum, or sac, until it is sufficiently capacious to contain a very large part of the alimentary canal. This condition we

see in those cases of enormous double scrotal hernia, which reach sometimes even below the knees.

Every hernial sac is composed of a body, or central part, above which is the neck, and below the fundus. The mouth, orifice, abdominal or ventral aperture (*le collet* of the French), is the point of immediate communication with the cavity of the peritoneum. To the tissues forming the margins or boundaries of this opening particular attention must be directed. These constitute, by their rigidity and unyielding texture, the principal impediment to the reduction of the hernia, in most cases; and it is, therefore, this part of the sac which requires to be cut in order to replace the protruded viscus within the abdominal cavity, when the reduction cannot be effected without opening the peritoneal sac.

The development of the hernial sac.—The evolution of the slowly-formed hernial sac has been very completely traced and described by Drs. Jules Cloquet[1] and Demeaux.[2] I shall here quote as briefly as possible the chief facts related by the last-named pathologist.

When the peritoneum, depressed by the pressure of the abdominal viscera, traverses the walls of the abdomen, it presents, at first, the shape of a digital depression; then of a funnel; and next, that of a finger of a glove. These forms are, however, somewhat dependent upon the region in which the hernia is developed. During this period the entrance to the hernial sac is larger than the fundus, and in these conditions a strangulation of the herniated viscus cannot take place. But when the fundus of the sac has reached those tissues which offer less resistance, it dilates, becomes rounded, and assumes a spherical shape; in this condition the entrance is more contracted than the fundus, and under these conditions strangulation may occur.

There are three periods or states in which the orifice and neck of the sac should be examined: 1st, of their formation; 2d, of their organization; and 3d, of their contraction.

The first period of formation.—It is important to describe the mode of formation of the mouth of the sac, since, from certain facts, conclusions which are useful in practice may be deduced. In the formation of the hernial sac it is demonstrable that the displacement of the peritoneum is a condition of more import than the stretching of the membrane.

When the hernial sac is complete, the portion of peritoneum employed to form it may be represented by a plain membrane about three inches in diameter and ten in circumference; whilst the centre of this surface is placed at the fundus of the sac at the most dilated part, the periphery, folded and puckered like the mouth of a closed purse, would be placed on a level with the opening at the narrowest part; that is to say, at the orifice of the sac, supported by the ring or the canal which the hernia has traversed. This puckering has been described by all authors, and in the plates of Jules Cloquet and Langenbeck the fact is delineated. It is also attested by preparations in almost all pathological museums. During this first period, the orifice and neck of the sac exist only in a condition to be preserved by a fibrous or muscular ring, which prevents the dilatation of the peritoneum; if this is returned into the abdomen by any mechanical means, the puckering disappears, and the orifice of the sac is effaced. If the fibrous ring is cut, or widely dilated, the same phenomenon takes place. The solution of the problem of strangulation of the intestine by the muscular or fibrous rings rests upon the study of this stage of the disease; for, at a more advanced stage, the orifice of the sac itself acquires an organization which sufficiently explains all the phenomena of which it is the focus.

The second period, that of organization. We may now examine the series of phenomena which take place in the neck and orifice of a perfectly-formed hernial sac. In the first period, the puckering only exists in such a condition as to be preserved by a ring, but, at a more advanced period, the different peritoneal folds form adhesions together, in consequence of the prolonged contact of their serous surfaces, and then the mouth or orifice of the sac exists independently of other structures; it becomes a new organ, annexed to the peritoneum, and has no longer need of being supported by the ring in order to exist. From this moment the orifice has an evolution peculiar to itself; it becomes the seat of very remarkable phenomena, which may be observed at different periods, and which may now be explained.

The serous surface is not alone the seat of morbid action relating to the organization of the orifice. In the subserous connective tissue changes of no less interest take place. The adipose tissue in this part diminishes, and even disappears, although the person be very fat. The connective and adipose tissues seem to be transformed into a new covering, which

[1] Recherches anatomiques sur les Hernies de l'Abdomen, 4to, Paris, 1817; and Recherches sur les Causes et l'Anatomie des Hernies abdominales, 4to, Paris, 1819.

[2] Recherches sur l'Évolution du Sac herniaire, etc., 8vo, Paris, 1842.

encloses a large quantity of bloodvesels. This rich vascularization is often seen through the transparent peritoneum of the periphery of the herniary opening, converging from all parts towards the orifice, and afterwards radiating on the superior part of the sac, where it is insensibly lost by blending with the connective tissue.

M. Demeaux considers that the organization of this annular induration begins in the sub-peritoneal connective tissue, and that at a certain time the peritoneum itself undergoes a change; it becomes vascular, and the two structures united together adhere closely. This induration of the internal surface of the orifice of old hernial sacs is due to an annular thickening of the peritoneum, nearly limited to the boundaries of the mouth of the sac, which is thus reduced to much less dimensions than any other part of it. Preparations demonstrating these conditions, with the exception of the vascularity, are preserved in the Museum of the Royal College of Surgeons and of the different hospitals of London.

A layer of fibres, which interlace in every direction and resemble the tissue of the dartos, is said to exist around the orifice of the sac. If these be contractile fibres, they must exert considerable influence to prevent the reduction of hernia, and may be considered as *one* impediment to that result. Are they not, probably, an excess of development of the contractile fibres of the connective tissue? M. Desprez considers them to be an exaggeration of the normal state. This dartos-like layer, having contractile properties, may also play its part in producing strangulation of some varieties of hernia.

The third period is one of contraction. Most writers on hernia have remarked the constant tendency which the orifice of the sac has to contract, and even to become obliterated, as soon as the herniated organs cease to act upon it.

This process is demonstrated in the cases of adhesion of the embouchure of the sac in infants; closure of its orifice in adults; and obliteration of the sac by persistence of omentum in its cavity. This termination, the most desirable of all, does not constantly occur. A gradual contraction may take place without the obliteration being complete; it is this disposition especially which gives rise to such formidable accidents.

At this period, if the orifice be examined anatomically, it is easy to prove that it has been the seat of a new transformation. In proportion as the tissues around the orifice become thicker and contract, their vascularity diminishes; and this layer, originally resembling the dartos, shows the firmness and resistance of fibrous tissue. In the second period, the orifice, susceptible perhaps of contracting spasmodically, may also permit of slight dilatation. In the third, all dilatation becomes impossible; either the margins of the orifice resist the pressure of the viscera, or the viscus which passes through the orifice becomes strangulated.

The tissues composing this annular contraction of the mouth of the sac often become nearly as hard as cartilage; and this change especially occurs in old cases, when the hernia has not been allowed to descend for a long time; for then the boundaries of the orifice are placed in the most favorable position for the process of contraction and induration to take place. But when the hernia is not reduced, the constant pressure of the viscera dilates the mouth of the sac as well as the fibrous rings.

Of the two kinds of hernial sac.—The "hernial sac" is always a prolongation of the parietal peritoneum from the abdominal cavity into the neighboring structures. Its development and formation, however, depend upon very opposite causes. Two kinds require to be described; the intrinsic and essential distinction between them depending upon their mode of development.

1. That kind which, being congenital, is merely a serous canal or sheath, the vaginal process of the peritoneum, until a hernia takes place and escapes into it, when it becomes converted into a hernial sac. The physiological designation for it would be THE CONGENITAL HERNIAL SAC.

2. That kind which is the result of a slow and gradual process of relaxation, and is produced by a stretching, yielding, or elongation of the parietal peritoneum, before and under the pressure of the viscus itself, which constitutes the hernia. For the sake of brevity, this kind may be termed THE ACQUIRED HERNIAL SAC.

The first kind, or congenital serous canal, which may become converted into the congenital hernial sac, sometimes exists throughout life simply as a diverticulum of the peritoneum, and without a hernia entering it; but the second kind, the acquired hernial sac, cannot exist unless a viscus, almost entirely invested by the peritoneum, pushes the parietal layer of that membrane before it.

In other words, the first kind of sac is peculiar to a person born with any portion of the vaginal process of the peritoneum open, and who then possesses a receptacle for the ready irruption of a hernia; and, if the ventral orifice and cavity of this sheath should not become obliterated soon after birth, a rupture may occur at any subsequent period of

life; but the second kind being an acquired formation, some length of time is necessary for its production, and it cannot exist at all without the continued and effective influence of the hernia itself.

Pott, writing of the two varieties of oblique inguinal hernia, the congenital and ordinary, expresses his belief "that common ruptures, or those in a common sac, are generally gradually formed, that is, they are first inguinal, and by degrees become scrotal; but the congenital are seldom if ever remembered by the patient to have been in the groin only."[1]

The paramount importance of a due appreciation of the physiological differences between the one kind of hernial sac and the other will be demonstrated in many points of view, but especially with regard to the surgical treatment of hernia.

The treatment of reducible hernia.—The surgical treatment of all kinds of reducible abdominal hernia is divisible into two categories:—

1. The employment of palliative or prophylactic measures.
2. The adoption of some proceeding designed to effect a permanent cure.

1. *Palliative measures.*—To this class belong all contrivances which prevent the descent of the hernia. These are the recumbent posture, bandages and trusses of various descriptions. If we only judge from the class of cases observed in the hospitals, and selected from among the laboring population, we should form a very inadequate estimate of the advantage which accrues to sufferers with hernia by the employment of well-adjusted trusses. We know of adult persons in comfortable circumstances, who, having no need for toil, have taken precautionary measures to prevent the recurrence of the rupture, and have consequently been free from everything of the kind for several years after. Some have even been enabled to dispense with the use of the truss entirely, after wearing it some months. It is, however, a condition of the utmost practical importance that the case be treated immediately that the disposition to the formation of rupture is detected. When the hernia enters the vaginal process of the peritoneum, and that sheath is converted into the hernial sac, we may effect a cure by attempting to call forth the processes adopted by nature to close its orifice and obliterate that canal; or, in other words, to procure adhesions of the serous surfaces of this peritoneal diverticulum.

On the other hand, in the slowly-forming hernial sac the object in making use of a truss should be, in the first instance, to prevent the development of the peritoneal sac. This may be accomplished by applying support to those weak parts of the abdominal walls through which the parietal peritoneum is forced. When, however, the sac is once developed—and this is commonly the period at which a surgeon is consulted—measures should be immediately adopted to assist in arresting its dilatation by preventing the descent of the rupture.

The expediency of judiciously pursuing the mechanical treatment of every variety of hernia cannot be too strongly urged upon the laity by the profession. In both sexes it should be carefully conducted the moment that the slightest protrusion shows itself. Whether the hernia occur in infancy, youth, at middle age, or at later periods of life, if properly watched and judiciously supported, it usually gives but little trouble; in many cases it is even cured. But, on the contrary, if it be neglected, increase in bulk, and, sooner or later, diseased states of the rupture, often leading to the death of the individual, will almost infallibly occur.

The only exception to be made to this rule applies to those rare cases of hernia into the vaginal process of the peritoneum in which the abnormal situation of the testis interposes a practical difficulty to wearing a truss, the necessary pressure of which occasions intolerable pain by compressing that organ simultaneously. But even such cases should not be abandoned as hopeless of cure, without a reasonable attempt being first made to afford relief.

The practice of leaving cases of rupture in the hands of mere tradesmen cannot be too strongly censured. Among the poor we constantly observe the lamentable effects of this proceeding. Ill-shaped trusses are applied; the springs, being too feeble, allow the hernia to descend behind the pad, where it becomes compressed; or they are too strong, and their pressure induces absorption of the abdominal parietes, on which the pad presses. Frequently a truss suitable for supporting a femoral hernia is applied to one of the inguinal kind and *vice versâ*. That which is worth doing at all is always worth doing well. This injunction receives strong confirmatory testimony in the treatment of ruptures by mechanical means.

Characteristics of trusses.—The requisite and essential qualities of a truss are lightness, firmness, elasticity, so that it shall retain the required form or shape, suitable adaptation to the configuration of the wearer, and sufficient strength of spring to prevent the escape of the rupture from the abdomen.

[1] The Chirurgical Works of P. Pott, edit. 1808, vol. ii., p. 120.

The instrument consists of a pad or cushion attached to a metallic spring, with straps, so arranged that its movement during the varied postures of the body may be restrained.

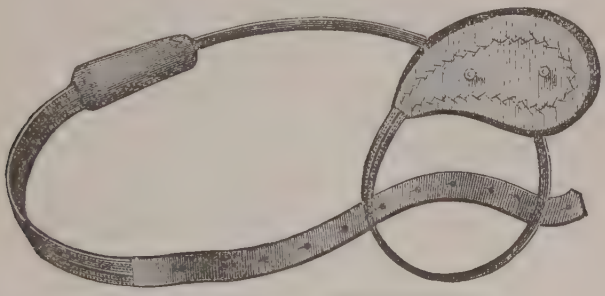
[A very important mechanical principle should always be borne in mind: that we cannot make effective pressure without having a firm point of support from which to make it. Hence trusses are much better for being provided with a posterior pad as well as an anterior one; the former being so placed as to bear upon a point opposite to the latter. This does not add to the cumbrousness of the apparatus, but enables the object to be accomplished with greater accuracy, and with a spring of less power.]

Through the kindness of Mr. J. A. Kingdon, Surgeon to the City of London Truss Society, we are enabled to give the results of his extensive experience in the employment of trusses.

He considers that the circular spring truss is the most suitable form, in the majority of cases. Bandages which are not elastic do not afford sufficient support to the hernia in every posture of the body. They are necessarily unsafe on this account, as they become lax in the stooping posture of the wearer—the position of all others in which the hernia most easily descends, because of the relaxation of the pillars of the external ring. The curve of the spring and the relative position of the pad with it should be appropriate to the configuration of the wearer. A single piece of metal should form the spring and foundation of the pad. As far as practicable, the spring of the truss should pass around the bony rim of the pelvis, fitting closely to the figure, and should lie out of the region of the glutei muscles. For, unless it be so placed, their alternate action in progression produces a corresponding movement of the pad. If these muscles be largely developed, extending upwards to the very edge of the pelvis, the curve of the spring should be wide at the shoulder, so that its bearing or resting part may be on the base of the sacrum.

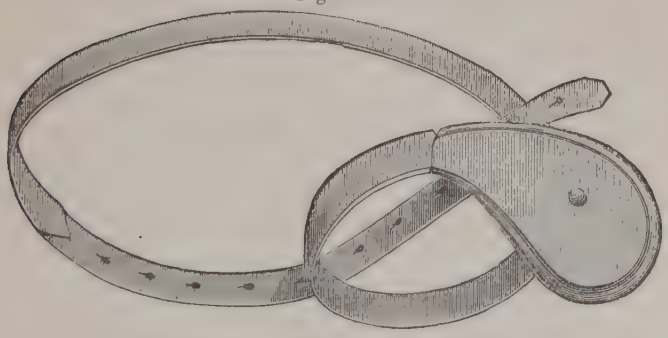
For a single pad truss the free end of the metal spring should be beaten out

[Fig. 407.



French model of truss. (Gemrig's catalogue.)

Fig. 408.



German model of truss. (Gemrig's catalogue.)]

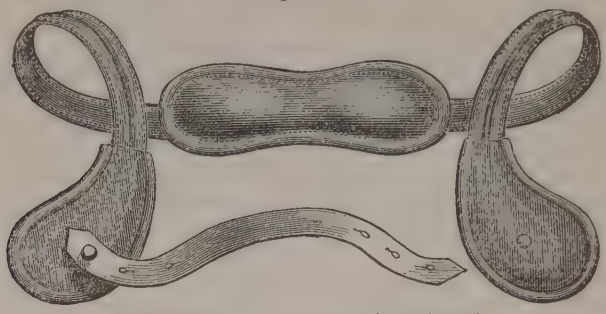
flat and thin, and so ground as to cling around the opposite hip—an arrangement which materially aids in steadying the truss.

The form of the spring may be designated as after the French model or the German. The former resembles the coil of a watch-spring, and is very elastic and clinging; the latter almost exactly fits the outline of the body in its state of repose.

It is almost inelastic, and very hard. The French is always pressing inwards, even when the wearer is at rest. The German scarcely presses at all when the abdomen is soft, but resists with power when any expulsive force makes the abdomen swell. In practice, the best shape for the spring is one which forms a medium between these two extremes.

[In the cuts (figs. 407 and 408) are shown the models of trusses known respectively as the French and the German. They do not really differ materially; although the German is usually made with a heavier and thicker spring than the French. Fig. 409 shows a double French truss, having a posterior pad, and one for either groin.

Fig. 409.



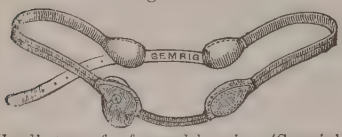
French double truss. (Gemrig's catalogue.)

In figs. 410 and 411 are shown the instruments known by the name of the inventor, Dr. Hood, of Kentucky; perhaps the most widely used American pattern.

Fig. 410.

Hood's truss for inguinal hernia. (Gemrig's catalogue.)

Fig. 411.



Hood's truss for femoral hernia. (Gemrig's catalogue.)

It is important that both the surgeon and the instrument-maker should thoroughly understand what is to be done, and how to do it.]

The pad or cushion should be of moderate dimensions. For the adult, it should not exceed two and a half inches in length, and two inches at the widest part. Its superior edge should follow the upper line of the spring, which falls a little from the shoulder or bend, where it lies in contact with the hip. The inner surface should be directed slightly upwards, but this inclination must depend upon the prominence, or otherwise, of the abdomen, as well as, in some measure, on the anatomical relations of the pelvis to the spine. The proper shape for the cushion or pad, and the materials of which it should be constructed, may be varied to accommodate particular cases, or to accord with the views of different inventors. Generally, the wearer discovers, after a little experience, which kind of pad is most free from annoyance. That pad, however, is the best which maintains perfect and unintermitting retention of the hernia. Every pad should have attached to it two studs, one near its junction with the spring, and another at its lowest point. To the upper one the transverse strap passing from the free end of the spring is attached. The lower stud is used with the thigh-strap, which should be always worn. [Some patients always object to this, and it may often be dispensed with, especially when the abdomen is very fully developed.] It is loosely fastened on to the spring of the truss near its shoulder, and should fall along the hollow beneath the buttock. In the erect posture of the wearer this strap should be moderately tight. It prevents the pad from shifting from its proper position, and should never be discarded.

These appear to be the general principles by which a surgeon is to be guided in the selection of a truss. Particular modifications suitable for special kinds of hernia will be noticed in other places.

Of the so-called radical cure of a hernia.—It would be idle to encroach upon the limits of this essay by describing in detail every method employed to effect a cure of hernia, from the most remote periods. A mere notice of them will suffice. They

were—castration; cauterization of the orifice and neck of the sac; ligature applied around the neck of the sac; incision of the sac, and subsequent healing of the wound by granulation; excision, suture, and scarification of the sac; detaching the sac from its connections and returning it into the abdomen; immediate and forcible compression of the sac by a bandage or truss; cold douche; stimulating injections, especially tincture of iodine. Such proceedings have been long abandoned, in consequence of the fatal results which frequently attended their employment.

[Another ancient method was that of employing the testicle as a plug for the hernial canal; a case in which this was successfully practised by a medical student upon himself is recorded by Dr. C. T. Hunter, in the Am. Journal of the Med. Sciences, Jan., 1878, p. 152. See also an article on this "Spanish" method, by Dr. Middleton Michel, ibid., Oct., 1878, p. 443.

It may be mentioned, also, that the plan of injecting stimulating substances into the canal has lately been advocated by Heaton and Davenport, of Boston (The Cure of Rupture, Reducible and Irreducible, etc., Boston, 1877). The article used by them is the fluid extract of quercus alba.]

We must, however, add the treatment recently adopted, namely, invagination of the hernial sac. Every modification of this operation is usually designated by the name of the inventor: thus there is the method of Gerdy, of Wutzer, of Rothmund, and others.[1]

The principle of this operation is expressed by the words, "invagination of the hernial sac." That is to say, the fundus of the sac is pushed up into its mouth, and retained there until adhesions have formed between it and the entire circumference of the orifice. By this means it is hoped that obliteration of the ventral orifice of the sac and of its cavity may become permanently established. It is an indisputable fact, that cases of reducible inguinal hernia have been permanently cured by the performance of an operation on the plan of Wutzer. We have not, however, the data by which to establish the proportion of cures to failures; but that a considerable number of cases operated upon did fail, is certain.

[In the United States a good many operations have been performed by different surgeons for the radical cure of hernia; but it would be difficult, if not impossible, to obtain anything like accurate statistics on the subject, and especially as to results. I have myself operated a number of times, and know of two cases only in which, three years afterwards, the patients were in no need of trusses. Of the others I had lost sight. Dr. Greensville Dowell, of Texas, has perhaps operated oftener than any other American surgeon, and has published a book on the subject, in which he claims marked success. His method will be further referred to.]

Mr. Kingdon has very kindly given me the notes of sixteen cases in which an operation for the radical cure of the rupture had been performed, either by London, provincial, or colonial surgeons. The patients applied to him for relief at the City of London Truss Society. In most of these persons, at the time they ceased to be under the observation of the operator, the rupture was "cured;" for reports of some of the cases appear in the medical periodicals of the day. In some of these patients the rupture was larger than before the operation, and greater difficulty was experienced in retaining it within the abdomen. In others a protrusion existed on both sides, the second having become developed after the operation.

Through the intervention of Dr. Hermann Weber, Physician to the German Hospital, I have received a valuable communication from Dr. Otto Weber, of Bonn, who was formerly clinical assistant to Professor Wutzer. The number of persons upon whom the Professor operated amounts to about fourteen. Between 1852 and 1856 the operation was performed but once in the "Klinik," during which time Dr. Otto Weber was clinical assistant to Wutzer. The patient was a teacher, forty years old. He quitted the hospital "cured," but the hernia returned in spite of his having worn a truss.

Wutzer is still of opinion—1. That when the operation is properly performed after his method, it is not attended with danger. 2. That he has succeeded in fixing the plug of skin with invagination of the hernial sac by inducing adhesions between its internal surface and the interior of its neck. 3. That in consequence of this, if the patient continues to wear a truss (for life), a return of the hernia may be avoided.

However, Dr. O. Weber writes, that he has never seen any of the so-called "cured cases" radically cured, but that—First, the plug of skin is, by degrees, entirely drawn out again. Secondly, that the true herniary apertures, the external and internal rings, are not closed by the operation; and, thirdly, that an imperfect cure may be effected by means of a partial closure, by adhesion of the internal walls

[1] The most complete account, especially of the German cases, is to be found in Günther, Lehre von den blutigen Operationen, Lieferung 50.

of the neck of the hernial sac, and thickening of the surrounding connective tissue.

The cases which Dr. O. Weber had an opportunity of examining some time after the operation, showed a slight protrusion of the intestine into the inguinal canal; and there would have been a perfect return of the hernia if trusses had not been worn. It appears that, at first, the invaginated skin becomes adherent to the inguinal canal, but without the participation of the hernial sac; that the latter probably becomes merely compressed by the invaginated skin passing by its side. In the most favorable cases the inner walls of the hernial sac may adhere together, but so loosely that they soon become separated by pressure.

The results of the examination of the bodies of persons after death upon whom the operation had been performed, are very important. Streubel has published some. Dr. O. Weber examined the body of a man who died of pneumonia in 1856, and upon whom Wutzer operated in 1840. The hernia had returned after the operation. There was not a trace of the invaginated skin in the inguinal canal, and the peritoneum did not show any signs of previous inflammation. The hernia and its sac did not differ from the ordinary cases of the same kind.

Dr. O. Weber thinks that Wutzer's method might be perhaps modified in such a manner as to become effective. But, first, he considers it is necessary to show upon the dead body that the fundus of the hernial sac can be actually invaginated into its orifice, and not merely pushed up a certain distance before the integuments.

But, instead of describing in detail the operation of Wutzer and its modifications,[1] let us inquire, what is the object the surgeon has in contemplation when proposing to perform an operation for the radical cure of a hernia? In order to be effectual and permanent, it must, of course, produce the obliteration of the hernial sac; the closure of its ventral orifice; the strengthening of those weak parts in the walls of the abdomen through which the rupture protrudes; and to these conditions must be also added, an improved tone of the peritoneal ligaments of the viscera, by which the power they exert in retaining the viscera in their normal situation is restored. Unless the operation perfectly and completely accomplishes these ends, failure must most certainly ensue sooner or later.

Another intention which the successful issue of the operation is expected to fulfil, is to enable the sufferer to dispense with the use of a truss, and thus to be free from an intolerable incumbrance. To recommend a dangerous operation, therefore, which may prove only so far successful as to impede the descent of a hernia, but yet leaves the patient under the necessity of continuing to wear a truss to prevent a recurrence of the rupture, is surely scarcely justifiable. It is contended by the advocates for the operation that the dangers to which the patient is subjected have been too prominently set forth. This may be true. Few persons have indeed died from peritonitis, or other causes, in proportion to the numbers upon whom the operation has been performed. But they all were subjected to that risk, and because they happily escaped the fatal complication, that is no ground for the inference that others would do so also. The facts only show that the operation may be done without exciting peritonitis in every case. [See statistics published by Prof. John Wood ("Address in Surgery," Brit. Med. Journal, Aug. 9, 1873), quoted in Am. Journ. Med. Sciences, Oct. 1873, p. 554.]

The surgeon, in the attempt to carry out his object, proposes to produce an effect in imitation of the processes of nature during the early periods of life; for there are facts to demonstrate that the cavity of the vaginal process of the peritoneum, which is, in so many cases, an apt receptacle for any protruded viscus, may become obliterated even after a hernia has passed into it in early infancy. But where is the evidence to prove that an acquired hernial sac becomes thus obliterated by similar natural efforts? The only instances, perhaps, are those in which the orifice of the sac is plugged by adherent omentum; and such cases are very rare.

We therefore believe that we shall not err in enunciating the principle that the cases of inguinal hernia selected for the performance of all operations for the radical cure should be those in which the protruded viscus has descended into a patent vaginal process of the peritoneum, and that all other kinds should be rejected as unsuitable; and that the more efficiently the proposed methods accomplish the ends effected by the processes of nature, the more worthy of confidence they become. Thus, allowing nature to guide our procedure, we must make it a rule to select those cases in which her efforts have failed; and by acting as her handmaid, we may reasonably hope to arrive at a successful result.

We may conclude these observations with the following quotation from the work of Mr. Lawrence: "The subject of

[1] Operations intended to effect the radical cure will be described with the treatment of the special kinds of hernia.

an incarcerated rupture submits to an operation in order to save his life. But he whose hernia is reducible, endangers his life to get rid of an inconvenience; and the operation affords no greater prospect of entire recovery than he had without it. For after he has undergone an operation, at the hazard of life, the complaint may return; and the only protection against relapse is to wear a truss" (Treatise on Ruptures, chap. vi.).

The morbid condition of the hernia, and impediments to its reduction.—A hernia is said to be reducible when the protruded viscera can be returned into the abdominal cavity; it is irreducible when they cannot.

The impediments to the reduction of a hernia may be classed in three groups: those produced by the tissues outside the sac; those occasioned by the sac itself; and those which exist within the sac.

There are also primary or immediate causes which render a hernia irreducible, as well as secondary. Among the first we may include all those impediments to reduction which depend upon organic conditions, and relate directly to the hernial sac; as, the muscular contraction which influences the size of the abdominal rings and the tension of the tissues around the orifice of the sac; the condition of the orifice of the sac itself; and the development within the sac of adhesions or omental sacs.

The secondary are those which are partly exclusive of the hernial tumor, and occur, as it were, accidentally, and are merely due to individual peculiarities; as, for example, the development of a thick layer of fat around the hernial tumor; its great mobility; its diminutiveness; tension of the sac from accumulation of the fluid or gaseous contents of the bowel; adherent omentum lying in front of the intestine; and some other conditions.

The morbid conditions of the hernia which give rise to more or less serious difficulties may be classed under one of the following states: 1. Permanent irreducibility. 2. Distension or inflation by fluid, gaseous, or solid contents, termed obstruction. 3. Inflammation. 4. Strangulation.

1. A hernia becomes permanently irreducible, after many years' existence, on account of its size. In most cases this condition is only attributable to neglect of the use of a truss. The largest double rupture I have seen was in a bricklayer, fifty-five years old, whose bodily health, strength, and conformation were in other respects very good. The left hernial tumor was the larger, although it had only existed about three years, whilst the right had been there twelve. The lowest border of the tumor very nearly reached to a level with the patellæ. Its circumference in the largest part measured thirty inches.

Adhesions also, when formed between the contents of the sac, or between the sac and its contents, prevent the reduction of the protrusion.

[It may be mentioned here that many old irreducible herniæ may be successfully dealt with by keeping the patient at absolute rest in bed, and on extremely low diet. See a case by the late Mr. Maunder, in the Lancet, March 16, 1878.]

2. Distension; choking; obstruction; rendering the hernia irreducible. This particular state or condition of a hernia is attributed to the accumulation of the solid, fluid, or gaseous contents of the alimentary canal within that portion of the bowel which constitutes the protrusion. From this cause the passage of the stercoraceous contents of the canal are arrested; the alimentary canal or tube becomes choked up with its own secretions and the egesta of the stomach, giving rise to local troubles and constitutional disturbance.

The doctrine of obstruction is of great antiquity, and for a long period that morbid condition of the hernia we now term "strangulation" was believed to originate in this cause alone. "During nineteen centuries," writes M. Broca, "the existence of an accumulation of fecal matter in the hernia had been admitted, or rather supposed: but when it was looked for the accumulation was not to be found. Thus theory fell to the ground on the first observation."

The local symptoms of an obstructed hernia are—pain, a flatulent state of the tumor, increase of size in comparison with its usual dimensions, more or less tension, and the absence of those more severe local conditions which characterize a strangulated bowel. By careful manipulation, the gaseous and fluid contents of an enterocele may be expressed into the contiguous part of the canal, and even solid fecal matter may be felt. During this proceeding the gurgling produced by the flatus and fluid is heard, and the movement of these is sometimes felt as they escape through that portion of the bowel lying within the orifice of the sac.

At first, the constitutional symptoms indicate functional disturbance of the alimentary canal, rather than any morbid state of the tissues of the herniated viscus. There are indications merely of a blocking-up of the tube, and nothing more. Thus, slight pyrexia and nausea, succeeded by vomiting, are the most marked features, which continue even although the large intestine below that

portion in the sac has been emptied of its contents after the commencement of the attack. Unless the vomiting be very prolonged, and great depression result therefrom, as occasionally happens in very delicate or old persons, the surgeon will not fail to remark the absence of the urgent symptoms characteristic of strangulated bowel.

In most cases of obstruction the impediment is removed by those means which excite the natural peristaltic movements of the alimentary tube. The local application of warmth and moisture to allay pain; repose; the administration of aperient enemata, or, even in some cases, when vomiting has not occurred, of purgatives, by the mouth, are beneficial. Abstaining, in the first instance, from manipulations of the tumor, is a point of great importance. Should the impediment to the passage of the indurated fecal matter depend upon the contraction of the orifice of the sac, the enlargement of this part becomes necessary, either by cutting its tissues or those around it. The operation must then be performed in the usual manner, and in relation to the special case.

3. *Inflammation of a hernia.*—A hernia in this state shows all the local signs, and excites the constitutional symptoms of inflammation. The combination of those indications which characterize the condition called strangulation does not, however, exist.

Inflammation is usually the result of external violence, and may be produced by the pressure of badly-fitting trusses. A morbid state of the whole alimentary canal, of an inflammatory type, may extend to the hernia, and in that way give rise to local trouble.

Irreducible epiploceles are more liable to be inflamed than other kinds of hernia; and a patient the subject of reducible epiplocele may have the hernia inflamed, from which cause it becomes permanently irreducible by contracting adhesions to the sac.

The local signs are—pain, increase in the bulk of the tumor, a certain degree of hardness, firmness, and elasticity when it is pressed, with more or less unevenness and irregularity of surface. The margins of the aperture through which the hernia passes do not tightly embrace the protrusion, so that, in a large hernia, the finger can be passed along the pedicle of the tumor for some distance.

The constitutional symptoms are not usually severe. In the first stages more or less pyrexia arises; and when the contents of the tube are arrested in their course, the indications of that condition become marked.

It is unnecessary to describe in detail the local and constitutional measures to be adopted. Reliance must be placed upon those in ordinary use to control and arrest the disease.

There occasionally happens a variety of hernia, first noticed by M. de Littré,[1] in which only a portion of the wall of the ileum, or a diverticulum from the bowel, becomes adherent to a very small hernial sac. By extension of inflammation to the neighboring viscera, obstruction to the passage of the stercoraceous contents of the tube arises, and death ensues.

Fig. 412.

Hernia at the femoral ring, of a part only of the walls of the bowel. The patient, fifty-six years old, had been ill nine days, when the exploration of a small swelling in the site of the left femoral ring was made. She was then dying, but survived the operation forty-five hours. After death peritonitis was found, and the intestines in the pelvis were united together. * The cæcal end of the bowel, the tube contracted between it and the hernia adherent to the sac. *a*. Intestine adherent to the sac. *b*. Peritoneal sac. *c*. Lobules of fat outside the peritoneal sac. (Museum Guy's Hospital, Drawing 484[20]—Preparation 2503[20].)

Fig. 412 illustrates this variety. It was drawn from a case which was under the care of the writer.

4. *Strangulation.*—A hernia is said to be strangulated when the displaced viscus is subjected to a constriction which impedes or arrests the circulation of the blood through its vessels, the passage of the stercoraceous materials along its canal, and constitutes an impediment to

[1] Obs. sur une nouvelle espèce de Hernie, Mém. de l'Acad. royale des Sciences, 1700, p. 300.

its return into the abdominal cavity. This condition excites constitutional symptoms of a most dangerous and characteristic nature.

[Although strangulation generally occurs at the neck of the hernial sac, it may take place elsewhere. See a case reported by Kapteyn (Med. News and Abstract, Jan., 1875, from London Med. Record, Dec. 2, 1874) in which it was caused by a firm ring at the lower part of a scrotal hernia. Dr. K. refers to another similar case seen by him in London in 1862.]

Is the condition of a hernia, termed strangulation, solely the result of mechanical constriction produced by the margins of the orifice of the sac; or does it depend upon a morbid action engendered in the tissues of the protruded bowel antecedent to its escape from the abdominal cavity? In several instances of strangulated femoral hernia in women, and in some cases of inguinal hernia in men, the patients themselves voluntarily stated that, for some hours before the hernia caused any inconvenience, or was even in the sac, their bowels had been "disordered," "relaxed," or that they had been suffering with "bowel complaint." In other cases, there seemed to be a great tendency to a very rapid derangement of the mucous membrane along the whole track of the canal above the hernia, scarcely explicable upon the supposition that it had been all excited by the mere existence of a constriction around a small knuckle of intestine. As evidence of this morbid action, I would adduce the fact of the rapid and abundant secretion from the entire mucous surface of the small intestines, their great distension and intense vascular congestion, witnessed in some instances.

Again, given any case of reducible hernia, which for months, or even years, has readily glided into the hernial sac, and has been returned as easily into the abdominal cavity, why on some particular occasion should it become irreducible when it has passed through the same orifice it has been in the habit of traversing, and in the tissues of which no appreciable changes have occurred? For it is in vain we seek any marked alteration in the structures around or composing the orifice of the hernial sac itself.

In giving an affirmative reply to the above inquiry, we are justified by facts in attributing the strangulated state of a hernia to a predisposing cause, commencing in a morbid state of the alimentary canal generally; at least, in some cases. Patients often relate how they had observed that the hernial tumor was "larger than usual" before they suffered much inconvenience; and this circumstance is commonly attributed by them to a greater bulk of the protruding viscus. But we have no proof that this is the correct explanation of the increase of size of the tumor in all cases; in some doubtless it may be. It is due to a distended state of the bowel rather than to quantity.

Let us examine a case of reducible inguino-scrotal enterocele. At one moment all that the surgeon can detect is a slight fulness produced by an empty hernial sac. At another, a small knuckle of intestine, having descended in an empty condition, becomes more or less filled with the stercoraceous contents of the alimentary canal from above it, and an elastic swelling results, which is produced by the bowel and its contents, fluid and gaseous. Assisted by the peristaltic movement of the viscus itself, or by gentle pressure, these contents of the tube are conveyed along the proper channel, and the hernia, that is the bowel, is emptied, and it readily resumes its normal position in the abdominal cavity. Observe, now, that the tissues of the bowel have undergone no change. But let the distension continue, and the first indications of mischief are local pain and an enlargement of the swelling; next, a sensation of uneasiness in the hypogastrium, of dragging from the rupture upwards, still greater increase in the magnitude of the tumor, and great pain when handling it, take place. Do we not recognize in these phenomena the peristaltic action of the canal, the swelling of the tissues of the hernia by congestion of its vessels and irritation of its nerves? During these progressive stages the protrusion has attained a size dependent upon more than one cause. Distension, caused by accumulation of its contents, and swelling of its tissues, induced by the effusion of inflammatory products, reacting against the narrow orifice of the sac, produce more or less retardation or arrestation of the sanguineous current in the bloodvessels of the rupture, and its strangulation is the result. The increased bulk of the protrusion prevents its retrograde passage through the small aperture by which it escaped from the abdomen. The body of the sac being also stretched, may mechanically contract the dimensions of its orifice in some measure; whilst the arrangement of the whole tumor, in relation to the mouth of the sac, may likewise afford an impediment to its reduction.

[Dr. Herman Lossen, by ingenious experiments, has shown that—

1. At the moment when the fecal matter enters the afferent end of the knuckle of gut, the efferent portion of the gut, at the level of the hernial aperture, is

pressed together, and by the constantly increasing pressure is finally completely closed.

2. This being accomplished, no pressure, however great, coming from above, will re-open the distal end of the gut.

3. The pinching of the intestine, which is generally referred to the opposed folds of mesentery, is not the cause, but the consequence, of this closure.

4. The afferent end is never closed.

The bearing of these facts upon the mechanism of the relief of strangulation is important, and may be found somewhat fully set forth in an article in the Am. Journ. of the Med. Sciences, Oct., 1874, p. 551, quoted from the London Med. Record, July 8, 1874.]

The filaments of the nerves of the injured bowel play an important part in transmitting thence to the nervous centres the local disturbance of their sentient extremities, and constitutional sympathies are excited. The heart contracts more frequently, and with greater force; the pulse is full and more frequent than normal; the cheeks are flushed; the surface of the body is warmer than usual, often moist, though sometimes dry; the tongue is covered with a white fur; nausea and intolerance of food are complained of; tenesmus occurs, and flatus or a small quantity of feces may be expelled, if the large intestines chance to contain any.

Uncontrollable retching and vomiting become the next established features of the disease; prostration of the bodily powers rapidly supervenes, and death may take place at this stage from collapse alone.

Enlarging upon this brief sketch of the symptoms which indicate the commencement and progress of strangulation of intestine, we must now systematically describe:—

First, the condition of the hernia when strangulated.

Secondly, the changes taking place in the tumor.

Thirdly, the constitutional symptoms excited by the local disease; and,—

Fourthly, the morbid conditions developed within the abdominal cavity.

The structural changes taking place in the hernia.—When the bowel is in the condition implied by the word "strangulation," the circulation of the blood within the vessels of the part is, at first, impeded. Congestion of the capillary vessels is the consequence, and the tissues of the viscus become swollen. When exposed to view, in this first stage, the serous membrane is of a deep-red tint, and through a lens the minute bloodvessels may be distinctly seen, with their outlines well defined. To the touch the hernia feels firm, and resists slight pressure; but the elasticity and resiliency of its tissues still continue unimpaired.

Next, the circulation of the blood is arrested. The tissues of the bowel, about which the constriction is tight, become now more swollen; they have palpably a solid, leathery consistence; the color of the serous surface is a dark purple; it is dull, lacks its usual lustre, and sometimes, varying as regards shade or depth of color, it is mottled with a red and purple tint. Patches of extravasated blood appear in the subserous connective tissue, and an adhesiveness to the fingers is very striking.

When the bowel has been strangulated many hours, its tissues are more swollen and soft; they no longer possess their characteristic elasticity, but they remain in the same position in which the pressure of the finger places them. The serous surface has lost all its characteristics; it is black, ash-colored, flocculent, and adhesive. In this stage all the tissues of the bowel have undergone more or less disorganization; blood is extravasated in the connective tissues between the different coats of the viscus; the mucous membrane is soft, flocculent, and easily detached from the fibrous walls. Probably in some part of the bowel, at its convexity, or where it is in immediate relation with the mouth of the sac, its tissues have sloughed, or ulceration is concealed by shreds or patches of adherent lymph. The intestine is also usually firmly fixed to the mouth of the sac by inflammatory adhesions.

The last stage is that in which the entire mass of the protruding bowel has become gangrenous, or has passed into a condition termed sphacelus.

In the diseased conditions just described we may recognize morbid changes similar to those which are observed in structures on the outside of the body. If a string be tied around the penis near the prepuce, the latter organ becomes first swollen, secondly, inflamed; thirdly, it suppurates; and lastly, it mortifies. Ulceration also takes place at the part with which the ligature is in contact.

The coats of the bowel are often ulcerated by the pressure of the constriction to which they are subjected, but the various tissues of which the viscus is composed are endowed with different powers of resistance to those morbid processes. Thus it may be seen, on cutting open the intestine, in cases in which the bowel has been deeply sulcated or grooved on its serous surface, without any trace of abrasion thereon, that the mucous membrane is ulcerated in a line corresponding to the part immediately embraced by the medium of constriction. Occasionally it

happens that the line of ulceration forms only at that end of the strangulated bowel directly continuous with the upper and distended portion of the alimentary tube, whilst there is none at the other end. This is probably caused by the pressure of the distended bowel within the abdomen, and it may be seen particularly in some cases where the knuckle of intestine lies in close relation with Gimbernat's ligament. We have even observed blood in the fecal evacuations of patients who have died with the bowel thus diseased.

Mr. Bryant states[1] that ulceration at the line of stricture is most frequent in inguinal hernia, although the sulcated condition of the bowel is as common in femoral as in inguinal; and that fecal extravasation, if not produced by ruptured bowel from taxis, generally follows ulceration at the line of stricture.

Small, recently-developed herniæ are more frequently strangulated than large ones, and those which have existed some time. Sir A. Cooper writes: "A small hernia is more easily strangulated than a large one, the pressure on the contents being more violent and the symptoms are much more urgent, as the stricture acts with much more effect upon a single knuckle in stopping its circulation, than when the contents of a hernia are large and voluminous."[2]

It is a matter of great importance to distinguish between the two classes of hernia—"RECENT" and "OLD." Mr. Pott observes: "Recent hernias are in general more liable to stricture than old ones, for reasons which are obvious from what has already been said; but when old ones get into the same circumstances, the symptoms are much the same; though I think in general they are not altogether so pressing, and the latter generally admit of more time to attempt reduction in."[3]

And very lately Mr. Bryant has demonstrated, by the cases admitted into Guy's Hospital, that in recent hernia strangulation frequently occurs, and that the risk attending it is very great, even although the bowel be speedily liberated.[4]

Morbid states of hernia induced by violent manual pressure.—Let it not, however, be assumed, that the morbid states of a hernia, above described, are always inevitably due to the compression which the orifice of the sac has exerted around it. Such is not the fact. The tissues of the herniated viscus are rarely so firmly constricted as to produce in a short space of time complete mortification, absolute death, of the whole of the knuckle of bowel in the sac; yet this state of hernia is often met with. In these cases the protruded viscus has been subject to another source of damage and destruction. Under the mild expression of "the use of the taxis," the hernia has been forcibly compressed by manipulation; its tissues have been contused and irreparably damaged; blood has been extravasated in profusion between the different layers of the tissues composing the viscus, and complete disorganization of its structures is the result of the injury inflicted. I have been for many years interested in ascertaining, from the observation of the state of the bowel after death, the comparative amount of injury inflicted on the viscus by the natural constriction of the orifice of the sac, with the tissues around it, and that produced by violent manipulation of the tumor, with the hope of reducing the hernia. I am constrained to state that the damage produced by the first cause is in no degree commensurate with that which results from the last; and that in all the instances in which the entire bulk of the herniated bowel was in a state of sphacelus, that condition was the result of violent, protracted, and ill-applied manipulation. The progress of these morbid processes is likewise accelerated by the same means; for it does not often happen that mortification of the whole piece of the bowel is observed in those cases in which the nature of the disorder happens not to have been recognized very early, and when the manipulation of the tumor has not been employed.

I may represent the danger which is associated with violent attempts to reduce the hernia, by stating, in a few words, that more irreparable damage may be inflicted on the bowel in a few minutes by coarse, careless, impetuous brute force, than the natural means of constriction could produce in several days.

Need I add, that in the attempts to reduce a strangulated hernia, the employment of such violence as must be necessary to produce these results is reprehensible in the extreme, and is justly condemned as not only opposed to every sense of humanity, and because it is in violation of all principles of practical surgery?

[Prof. Scheide, of Halle, is an advocate for the use of greater force and perseverance in the taxis than is generally employed, or considered justifiable. His views, which seem to me to be open to great objections, may be found in the

[1] Guy's Hospital Reports, 1856.

[2] The Anatomy and Surgical Treatment of Abdominal Hernia, part i., chap. vii., the last paragraph.

[3] The Chirurgical Works of P. Pott, edit. 1808. vol. ii., p. 63.

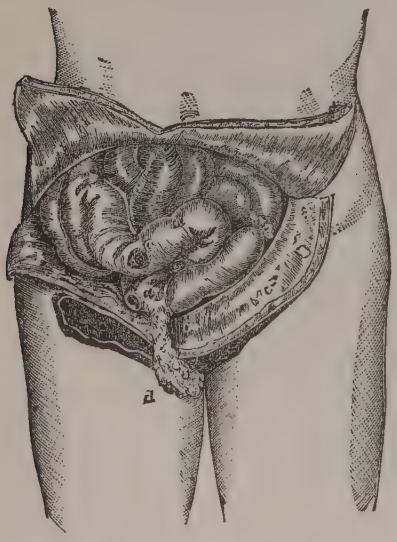
[4] Guy's Hospital Reports, 1861.

Med. Times and Gazette, Nov. 14, 1874; or in the Med. News and Abstract, Jan. 1875, p. 29.]

Artificial anus.—Two conditions of the intestine lead to the formation of an artificial anus. One, in which a portion only of the wall of the intestine sloughs, leaving a small ulcerated opening as if a piece had been punched out, which does not interfere with the continuity of the alimentary canal, although it allows a portion of its contents to escape. This opening commonly forms at about the centre of the convex free border of the knuckle of intestine, and at a point farthest removed from the orifice of the sac.

Another variety is due to ulceration of all the coats of the bowel, even to the mesentery. It usually occurs in the part of intestine at the mouth of the sac; and, in consequence, the continuity of the canal is destroyed, and all the stercoraceous matter escapes through the opening.

Fig. 413.



Artificial anus after strangulated ileum, at the convexity of the tube. The patient, seventy-two years old, was the subject of strangulated femoral hernia for "two days," but probably more, when the protrusion was returned by operation. The bowels acted freely by the anus, but on the fifth day from the operation fecal matter was discharged from the wound (*b*). Feces continued to pass through it until death, which took place seventeen days after the operation. The perforated bowel was the ileum, about a foot from the cæcum, which is seen in the wood-cut (*a*). It is raised from the mouth of the femoral aperture to show it more distinctly. Fecal extravasation into the peritoneal cavity was prevented by adhesions between the margins of the perforation, neighboring coils of bowel and omentum (*c*, *d*). The patches or marks on the coil above and behind are the remains of those adhesions. (Drawings, Museum Guy's Hospital, 486^{6}.)

Figs. 413, 414, show the appearances before described.

Intermediate between these two extremes we meet with varieties in which more or less of the walls of the tube are destroyed, producing corresponding results. I may state that, after the first accident, repair of the hole frequently takes place, the wound of the integuments heals perfectly, and complete recovery ensues. [For instances of this kind, see Am. Journal of the Med. Sciences, April, 1870, p. 430; British Med. Journal, Jan. 29, 1870; Am. Journal of Med. Sciences, Oct. 1877, p. 456.]

After the second, however, the prognosis is not so favorable; for, commonly, an artificial anus is permanently established, and more or less of the contents of the alimentary tube are discharged thereat.

As the result of long-continued constriction by the mouth of the sac, and the pressure made upon the two pieces of intestine lying therein, their walls become adherent at the points of contact, ulceration takes place, and the continuity of the tube is thus established within the abdomen, by the processes of nature alone. This condition is very rarely met with, and I may therefore refer the reader to a published case.[1]

Morbid conditions of the coverings of the hernia.—The changes taking place in the tumor affect the hernial sac and its coverings or investments. When they are purely the result of disease induced by strangulation of the hernia, they extend progressively from within outwards; but if produced by violence in the manipulation of the tumor, the integuments show early indications of the injury by ecchymosis, as well as inflammation of the subcutaneous connective tissues, œdema, etc.

The severity of the pain caused by handling the tumor when the hernia is strangulated, differs in a remarkable manner in different individuals. In some persons the tumor becomes quickly sensitive, and even intensely painful, so that the patient is intolerant of the most gentle manipulation, especially in the region of the orifice and neck of the sac. Sometimes, in cases of acute strangulation especially, the sufferer can scarcely be induced to lie quiet in bed, but writhes about in torment, praying for instant relief. Other patients, on the contrary, endure the necessary examination and even pressure of the tumor, without evincing very marked signs of pain.

At indefinite periods, after symptoms of strangulation of the intestine have appeared, the size of the tumor often increases rapidly; its surface becomes more

[1] Transactions of the Pathological Society, vol. x., p. 128; the preparation is preserved in the Museum at Guy's Hospital, No. 2492^{0}.

Fig. 414

Illustrates that variety of artificial anus in which the continuity of the tube is destroyed in consequence of destruction of the entire calibre of the bowel. From a case of femoral hernia in a woman sixty-seven years old. The bowel had been strangulated fifty-five hours when herniotomy was performed, and the intestine reduced into the abdomen. Four days afterwards feces escaped from the wound. Sloughing took place around the wound, and the woman lived three weeks. *a*. Symphysis pubis. *b*. Fistula leading from the intestine *d*. The lower end of the ileum *f* ending in the cæcum *e*. *c*. Part of the abdominal walls. (Drawing, Museum Guy's Hospital, No. 4865.)

uniform and regular; the integuments tense, smooth, shining, red, with increase of temperature; and the general outline of the whole swelling assumes a more pyriform shape, or is more locally circumscribed, according to the variety of the hernia. Fluctuation may also be detected in some cases. It must, however, be remembered, that the displacement of gas by pressure upon the tumor causes a sensation very closely resembling that which indicates the presence of fluid, and that the difference between one and the other is not always perceptible even by surgeons of great experience in delicate manipulation.

The sudden enlargement of the tumor is explained by the fact of a rapid secretion and accumulation of serum within the hernial sac, in numerous instances; by the distension of the enterocele with gases, in others.

Characters of the serum in the sac.—The serum varies in character according to the duration of the strangulation. When the sac containing a strangulated hernia is cut open, some fluid usually escapes. In color, consistence, and odor, this serum varies considerably in different cases; and these diversities may be regarded as important indications of the condition of the tissues of the strangulated bowel.

It is pale yellow, clear and bright, when strangulation has existed a few hours only; and, under these circumstances, the intestine is simply deep-red, from vascular congestion, and its tissues elastic.

It is dark-brown, but clear, when strangulation has existed many hours; and the intestine is then of a purple tint, but its tissues elastic.

Its color resembles that of a strong infusion of coffee; it is turbid; blood and small coagula are mingled with it, when the protrusion has been long strangulated, or protracted and violent taxis employed; now the intestine is dark purple, inclining to black; its tissues are leathery, not resilient, infiltrated with blood, and often flakes of lymph are adherent to its surface.

When turbid, dull brownish-yellow, and containing blood, coagula, pus, flakes of lymph, and even fecoid matter, in which state the odor of feces is perceptible, the intestine is usually approaching a gangrenous condition, if it have not already passed into sphacelus.

The escape of gas through serum, of the nature last described, producing bubbles, is an indication that the herniated bowel is probably ruptured, and that a communication exists with the interior of the alimentary tube.

If the progress of the disease be not arrested by the liberation of the bowel, its tissues mortify, the coverings of the sac become inflamed, infiltrated with serum, and at last with pus. Crepitation may be felt, which arises either from the development of gases in the decomposing tissues, or depends upon their escape from the alimentary tube; and finally gangrene of the skin ensues, and through the opening caused by the separation of the slough the contents of the intestinal tube escape, and an artificial anus is established.[1]

[1] John Hunter writes: "It is very curious to observe in hernias, that while the gut is in the sac and alive, no inflammation takes

In cases of entero-epiplocele, after the reduction of the intestine by the taxis, the irreducible omentum sometimes becomes inflamed, and, together with the sac and its coverings, suppurates, sloughs, and becomes detached in the usual manner; the patient subsequently making a good recovery.

Constitutional symptoms induced by the morbid state of the alimentary canal above the hernia.—Many of the general or constitutional symptoms of strangulated hernia are excited by the morbid condition of the part of the alimentary canal above the portion herniated, more than by the state of the hernia itself. The simple obstruction to the passage of the stercoraceous contents of the tube induces severe constitutional disturbance; an illustration of which is afforded by cases where the canal is crossed by fibrous bands, or directly compressed from any other local cause.

There are so many functions disturbed by the retention of the hernia in the sac, that it is very difficult to assign the constitutional symptoms to any single circumstance, such as the constriction of the hernia. Yet it is almost impossible to deny that some very marked influence arises from this single cause alone; for what change is more marked or striking than the cessation of vomiting immediately ensuing upon the liberation of the bowel? The hernia is indisputably the primary and exciting cause; but much of the constitutional disturbance must be referred to those morbid phenomena which progressively arise as the result of mere obstruction of the alimentary canal.

We may consider these effects of obstruction under two heads. First, those produced in the portion of the viscera within the abdomen; second, those excited in the nervous, respiratory, and vascular systems.

Effects of obstruction.—That part of the alimentary canal which is between the stomach and the hernia becomes by degrees distended with flatus and fluid of a dark-brown color. The mucous membrane is deeply injected, sometimes of the color of blood. The serous membrane is also red, from vascular turgescence; and often patches of a deep-red tint produce mottling of its surface. After long protracted distension, the contractile tissues of the small intestine seem to lose their function, which in some cases they never regain. When obstruction occurs to a part of the colon, the patient may die from perforation of the coats of that bowel, or even of the cæcum. The portion between the hernia and the anus, whether small intestine or large, is contracted; the mucous and serous membranes are generally pale. The bowel often contains a little tenacious mucus.

Results of peritonitis are seen after death in the form of shreds of plastic lymph adherent to and lying between the coils of the bowels; or a large quantity of sero-purulent effusion occupies the peritoneal cavity.

Constitutional symptoms of strangulated intestine.—The constitutional symptoms, which are regarded as indicative of strangulated intestine, when associated with a local tumor in any site of a hernia, become marked and highly characteristic after vomiting has once commenced.

That train of symptoms seems to be mainly due, first, to nervous irritation starting from the herniated viscus, and afterwards to the interruption of the passage of the stercoraceous matter; for any circumstance producing mechanical obstruction causes very similar results. Thus, if any part of the alimentary tube be confined by adhesions, pressed upon by a tumor, or ligatured by a fibrous band within the abdomen, many of the results attending the accident resemble those of strangulated hernia. Likewise somewhat similar symptoms attend ileus, enteritis, and some forms of constipation.

It is perhaps correct to state that certain characteristic phenomena taking place in association with a tumor, at a site where it is known hernia commonly, or even rarely, occurs, would lead to the inference that a portion of bowel had become strangulated, especially if certain local indications, superadded to mere swelling, also existed.

[When there is fecal vomiting, with tympany of the abdomen, and absence of emissions of wind from the anus, strangulation may be positively assumed to exist.]

Usually, the first symptom the patient complains of is vomiting. Upon careful inquiry, however, it is commonly stated, especially if the case be one of old hernia,

place on the sac or integuments; but the moment the gut becomes mortified or dead, the stimulus of an extraneous body takes place immediately; an outlet is then endeavoring to be made by the inflammation and suppuration of the sac forming an abscess in it; which matter, with the contents of the gut, is brought to the skin. While this is going on, the sound gut within the abdomen, where it passes into the rings, adheres to those rings all round; so that when the abscess is formed, burst, or opened, and the mortified parts sloughed off, these ends of the gut open into the abscess, and not into the cavity of the belly."—Hunterian Ms. Descrip. Cat. of the Path. Specimens in the Mus. Roy. Coll. of Surgeons of England, vol. iii., p. 117.

that more than usual pain has been experienced at the site of the tumor; or that, for some hours before, it was observed to be larger than usual. Nevertheless, so little trouble is sometimes occasioned by the tumor, in the first instance, that patients often attribute the protrusion of the hernia to the effects of the straining in the act of vomiting. Occasionally, too, soon after rising from bed in the morning, the patient complains of nausea, which is rapidly succeeded by vomiting, without being previously aware of the existence of any hernial tumor. This is frequently the history of females, who perhaps have been toiling laboriously the day before. The same likewise happens in persons who, knowing themselves to be ruptured, and having never worn a truss, designedly conceal the fact. So little local inconvenience is sometimes caused by the hernia, that the attention of patient and medical attendant being entirely engrossed by the act of vomiting alone, both remain in ignorance of the existence of the hernia.[1] Upon enquiry it may be elicited, if the patient enjoys ordinary intelligence, that before the nausea commenced, a sudden sensation of uneasiness was felt in the abdomen, especially about the hypogastric region; that this was followed by a repeated desire to go to stool, with tenesmus, and that nothing but a little flatus escaped.

Nature of the vomit.—The composition of the vomit varies at different stages of the illness. At first, it usually consists of the substances last swallowed; next, principally of yellow bilious fluid, which after a time changes to a greenish hue; until at last the color changes to brown, and resembles more or less closely, especially in odor, a mixture of feces and water. It is then termed feculent, or stercoraceous.

During the active stage of vomiting the sufferer is unable to retain anything on the stomach for any length of time. But as an extreme state of prostration of the nervous system becomes more and more imminent, and also if the narcotic effects of opium be induced, the irritable condition of the stomach subsides, and may cease altogether. The surgeon must not, however, be thrown off his guard by this apparent calm. His anxieties must not cease in consequence of this composed state of the patient. On the contrary, it betokens a most dangerous depression of the vital powers, a degree of exhaustion from which some persons never rally.

The stage of prostration is now established. The pulse, which during the earlier hours of the attack was more full, and beat more frequently than normal, and which, as the vomiting continued, became weaker and more rapid, now beats slowly and with little force. The surface of the body is chilled; the hands and feet are blue, their integuments shrivelled; the aspect of the countenance is one of anxiety and distress; a peculiar expression as of suddenly increased age is very characteristic; the muscular system has lost its tone; the tongue is dry, furred, and frequently brown; and the secretion of urine falls below the normal standard of quantity. At this stage the hernia is sometimes reducible. The most gentle manipulation suffices. This occurs more commonly in inguinal hernia than femoral. It probably depends upon the relaxed condition of the abdominal muscles, and the removal of the constriction they once exerted around the mouth of the sac; in the same manner as chloroform exerts a beneficial influence. Death occasionally takes place at this period of the attack. This fatal issue is attributable to the extreme prostration of the nervous system, induced by protracted vomiting; for in after-death examination of such cases we do not find any organic lesion to cause it.[1]

[1] *Importance of searching for a hernia in certain cases.* In consequence, therefore, of the fatal results which almost inevitably ensue if a strangulated intestine be not speedily liberated, it is the paramount duty of every medical man, when called upon to afford relief in cases of continued vomiting, to examine those regions of the abdominal walls in which hernial protrusions take place.

After long hospital experience, during which time the number of cases of hernia coming under our observation has been very large, many of which had been entirely overlooked until the last stage, we feel it our duty to allude to another cause of destruction. Among the poor it has frequently happened that a friend of the sufferer has gone to a chemist's shop to relate the symptoms, and vomiting and constipation being the most prominent, drastic purgatives were prescribed, and repeatedly swallowed by the patient. Thus, not only was valuable time lost, but treatment of the most injurious kind adopted.

[1] Mr. Obré showed a dissection of a case of entero-epiplocele illustrating this fact, at the Pathological Society (Path. Trans., vol. vii., p. 219). A woman, fifty-three years old, died after four days' strangulated bowel, without receiving medical advice. After death a small portion of intestine was found perfectly strangulated in the left femoral ring; it was intensely blue, but its tissues unaltered. The small intestines were preternaturally red, but not inflamed.

M. Malgaigne also reports a case of the same kind. Strangulation of the intestine had existed eight days, when the woman

The next stage, characterized by distinct symptoms, is after the development of peritonitis. But this does not always occur over so large an extent of surface as to excite grave apprehensions for the result. Peritonitis is often purely local, and confined to a small area around the region in which the hernia is situated. Perhaps the local inflammation is only just sufficient to produce adhesions between the orifice of the sac and the protruded intestine. However, when general peritonitis is developed, the usual symptoms of the disease are well marked. Hiccough is especially regarded as an unfavorable indication. Peritonitis, in the most severe form, arises when the walls of the bowel have been perforated by ulceration, thus allowing their contents to escape into the peritoneal cavity. Intense abdominal pain immediately follows this accident, collapse supervenes, and death speedily releases the sufferer.

The last stage is collapse: a condition in which the vital powers scarcely seem to exist any longer; the sufferer, although not physically dead, yet seems to linger on the threshold of that state. The patient may continue some hours pulseless; the extremities cold, and the breath also; the facial aspect deathlike; the power of speech but slightly impaired; until a sudden change comes over the features, and life has departed.

We have before described the pain felt in the hernial tumor. Besides this there is a peculiar sensation of tightness or constriction referred to the umbilicus. This is a highly characteristic feature of a strangulated hernia. The patient describes the suffering as resembling the effect which would be produced by encircling the mesogastrium with a tightly drawn cord. To this is sometimes added a dragging sensation, extending from the epigastrium to the hypogastric region.

Pain, regarded as a symptom of peritonitis, is an uncertain indication. This disease frequently exists without much pain being experienced, and even pressure on the abdomen is endurable without causing complaint. Pain is more particularly absent in those cases where peritonitis arises without ruptured bowel. If, however, fecal extravasation be the cause of the peritonitis, then the pain immediately becomes intense, often agonizing, indeed pathognomonic of that occurrence.

[It must not be forgotten that cases are upon record in which the symptoms of strangulation have been present without the existence of a hernia. See Theilhaber, London Med. Record, June 15, 1877 (quoted from Aerztl. Intelligenz-Blatt, 7, 1877).

There are also various complications of hernia, as abscess, fatty or other tumors, aneurism, etc., by which the diagnosis may be greatly obscured. An interesting example of this kind, in which a ruptured aneurism was coincident with an old inguinal hernia, was recorded by Maunder (American Journ. of the Med. Sciences, July, 1873, from Med. Times and Gazette, May 24, 1873). Other instances have been at various times reported.]

Prognosis of strangulated hernia.—Hospital experience must not be regarded as a fair criterion by which to judge of the mortality induced by the effects of strangulated hernia alone. The high rate of mortality observed in this class of patients can only be considered as the result of the nature of the cases admitted into hospitals for treatment. In a large proportion of them the prospects of saving life are passed before the sufferers even leave their homes. Men and women laboring under the most adverse circumstances, irrespective of the particular disease under observation, are, for the most part, the class of sufferers submitted to treatment. Their constitutional powers have been previously and irreparably reduced by habits of life, places of residence, persistent recklessness, and usually by compulsory submission to almost every condition the reverse of those conducive to health—such are the cases hopelessly seeking to be cured. These facts alone are sufficient to account for the mortality which occurs in our hospitals in cases of strangulated hernia requiring a cutting operation to liberate the bowel.

Undoubtedly it is to the length of time for which the bowel is allowed to remain strangulated, and to the delay in the performance of the operation for its liberation, that the high rate of mortality must be generally attributed. This circumstance cannot be too strongly impressed upon the mind of the patient; nor can the medical attendant act too promptly in the employment of the only treatment which can avert such untoward results.

The late Mr. James, of Exeter, was evidently surprised at the mortality occurring in the hospitals of London when he observes: "There can be little doubt that the majority of these fatal cases (of hernia) were the victims of time; . . . this, I am aware, is an error little imputable to the distinguished surgeons by

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died. There was neither gangrene, ulceration, nor peritonitis. He then observes that we see that a strangulated hernia excites such an extreme depression of the vital powers that patients may succumb without any anatomical lesions appearing to produce that event.—L'Union méd., 1854, p. 248.

whom these operations were performed. It is generally the unfortunate patient who is the cause of his own disaster."[1]

This statement very truthfully represents the state of the case, in some instances, without doubt—in those, for example, in which the patient, being conscious of the existence of the rupture, conceals that knowledge from his medical attendant, or refuses all interference beyond external or internal therapeutical agents. It does not remove the imputation of neglect from him who, when the case is under his medical care, leaves his patient for several hours in suffering; nor can it justify the delay which is caused by a surgeon who, duly appreciating the nature of the illness, refrains from liberating the constricted bowel, or asking others to do so, after appropriate means have been unsuccessfully employed to return it by the taxis.

We have never known an instance of a patient dying in consequence of the bowel being liberated at too early a period; but we have had to operate upon many whose chances of life were absolutely sacrificed by the inexcusable delay which had occurred before the patient was submitted to the operation. We make this assertion after a large experience, extending over many years.

Why is it that the mortality attending strangulated hernia is so large? How does it happen that every writer upon this disease and every hospital surgeon has to deplore the condition of patients subjected to the operation for the liberation of the bowel? The average annual mortality in this metropolis caused by hernia, and published by the Registrar-General, amounts to 148.[2] This average is calculated from the total number of deaths from this cause registered during the last thirteen years. The highest number recorded is for the year 1862, viz., 170; the lowest in 1850, 128. We may assume that the increase of population, and greater accuracy on the part of those certifying the causes of death, may account for the difference between these extremes—42. Now, judging from the condition of the cases which have come into hospital under our own care, we believe we are correct in stating that the mortality might be reduced at least by two-thirds if the liberation of the bowel was effected immediately after the failure of judicious attempts to reduce the hernia by the taxis, assisted by proper means, or soon after the vomiting of fluids regurgitant from the intestinal tube. We do not hesitate to pronounce this judgment after carefully ascertaining the facts of the cases which have fallen under our own treatment. For example, in inguinal hernia: of eight fatal cases, three were incurable in consequence of the condition of the bowel, irreparably diseased by long-continued constriction; two others were in a similar state from the bowel having been injured by violent compression employed to reduce it. Cases of femoral hernia are even still more fatal from the causes above mentioned. In twenty out of twenty-eight, the immediate cause of death was attributable to the disease of the bowel which had formed the hernia; this morbid state depending upon injury, over which the mere liberation of the bowel exerted but slight influence towards repair. For it should be remembered that the simple replacement of the viscus in the abdominal cavity does not insure the restoration of its functions; the surgeon only replaces it in that situation where the reparative powers of nature are most likely to exert their influence with activity; and that if the tissues of the hernia when reduced are incapable of performing their functions, those of the intestine cannot be performed, and therefore death must ensue. In several of these cases the disease of the bowel was rendered still more surely irreparable by the pressure to which it had been subjected in the taxis; and in two instances the damage inflicted by this means was so great as to have absolutely killed the entire coil of intestine which was in the sac (fig. 415).

But all the causes which produce the morbid conditions of the bowel above mentioned, and more fully detailed in preceding pages, can be prevented. They may not be always under the control of the medical attendant, nor amenable to surgical skill; but we confidently promulgate the doctrine that the salvation of life in cases of strangulated hernia entirely depends upon the liberation of the bowel at the earliest moment practicable; and the converse may be predicated, that the destruction of life will inevitably ensue in proportion to the length of time the constriction has existed, with its constitutional consequences, and the prolonged and forcible taxis employed.

The vital importance of liberating the bowel from constriction at the earliest moment cannot be over-estimated. As upon the speedy accomplishment of this the salvation of life depends, a little precipitate action may even be forgiven, so hazardous is the position of a patient with the bowel strangulated. But, what is the risk attending the operation of ex-

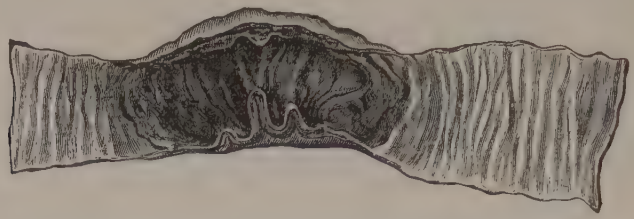
[1] Practical Obs. on the Operations for Strangulated Hernia, p. 79, 8vo., 1859.

[2] Summary of Weekly Returns of Births and Causes of Death in London; published by the authority of the Registrar-General, 1863.

posing the hernial sac, dividing the impediment to the reduction of the hernia, and reducing it, even should the peritoneal sac require to be opened? Practically, none. In comparison with that of leaving the bowel strangulated, it is harmless.

To what causes, then, may we attribute the culpable negligence of those who leave the poorer classes of the community in this most perilous moment—in a condition replete with jeopardy, fraught with results hazardous in the extreme? It would seem that the embarrassment and

Fig. 415.



This woodcut represents the injured tissues of a knuckle of small intestine which had been violently contused during efforts made to reduce it. The dark shade between the serous and mucous membranes represents blood extravasated in the walls. The whole of the knuckle was gangrenous, although it had been strangulated only a few hours. The lines of ulceration in the mucous membrane are distinctly seen. (Copied from a colored drawing and preparation in Guy's Hospital Museum.)

the delay are caused, not by surgeons being timid and slow to propose a remedy, but from their really being ignorant of the amount of mischief certain to arise by allowing the constriction of the bowel to continue.

We once heard a physician relate the following circumstance: Being asked to see a poor woman who had been vomiting for several hours, he discovered a hernial swelling. He suggested that a surgeon should immediately see the case, intimating that an operation was urgently needed. The gentleman in attendance replied, "But will it not be desirable to wait until the vomiting has ceased before the performance of the operation?"

Can any principle be deduced from the facts detailed, to serve as a guide in determining the moment at which the attempts to reduce the hernia by the taxis should be given up, not only as hopeless of good results, but fruitful of pernicious effects, and a cutting operation be urged as the only safe means to liberate the bowel from constriction? We may certainly now assert this without fearing the accusation of too great precipitation: when the period has arrived at which it is certain, from the nature of the fluids vomited, that regurgitation of the contents of the duodenum and jejunum has taken place, any delay in effecting the reduction of the bowel is certain to be attended with progressively increasing evils. If there be evidence of regurgitation from the ileum, the condition of the patient is still more hazardous. Even assuming that the case be now seen for the first time at this period, and that attempts have not been made to reduce the protrusion, delay is inadmissible. The administration of chloroform [ether] should be recommended at once, with an understanding between the patient and the surgeon that the operation should be immediately performed if, when its anæsthetic effects are fully developed, he fails to reduce the hernia by manipulation.

M. Desault, fully appreciating the injury too often inflicted on the hernia by the injudicious and violent employment of the taxis, wrote: "Always think favorably of a case of strangulated hernia when the taxis has not been used."

About two years since I operated upon a case of femoral hernia in a woman who had been laboring under symptoms of strangulated intestine for fourteen days. This was carefully ascertained. The bowel was thickened and like a piece of leather. Taxis had never been employed, and this patient recovered perfectly. [Mr. Howard Marsh (St. Barth. Hosp. Reports, vol. x., 1874) gives an analysis of 47 cases of strangulated hernia in children, and shows that the rule should be, in children as in adults, to resort to herniotomy upon the failure of one well-ordered and careful attempt at reduction, the patient being under anæsthesia.]

Treatment of irreducible hernia. Reduction of the hernia by the taxis.—The endeavor to reduce the hernia, which consists in displacing it from its abnormal position, and passing it through the orifice of the sac into the peritoneal cavity, by dexterous manipulation, is termed the use of the taxis. Of course, the first desire upon the part of the surgeon is to accomplish this feat. But all attempts to replace the bowel in the abdominal cavity should be relinquished until the circumstances attending the special case under observation have been carefully ascertained and considered.

The principal circumstances to which attention should be directed are as follows:—

1. The kind and variety of the hernia regarded in its anatomical relations.

2. The duration of its existence; whether it be of old standing and slow formation, or of recent and sudden development.

3. The constitutional condition of the patient at the immediate moment, as influenced by the present illness. The hour at which vomiting commenced; and the variations which have taken place in the composition of the fluids vomited should be determined with exactitude.

4. The state of the tumor. Its usual size when not causing illness; its bulk before vomiting commenced; the changes which have taken place in it during this stage; the pain to which it gives rise, if merely local or extending into the abdomen, with or without manipulation; the condition of its coverings; its probable contents, so far as may be conjectured by the evidence, assisted by touch and sight.

5. The treatment already adopted by the patient, the friends, or other persons, before the observation of the surgeon.

These are all subjects upon which profound reflection and serious meditation are urgently demanded.

Injurious effects produced by the taxis.—It is necessary to state once more that irreparable injury is frequently inflicted upon the herniated bowel by violence, used at all stages of the illness. The danger of any mischief occurring by the use of the taxis increases in proportion to the length of time the bowel has been strangulated. This necessarily arises from the tissues of the viscus becoming less and less able to resist the pressure of the hand in consequence of a morbid state due to the constriction.

The principles by which the surgeon should be influenced, when he is desirous to reduce a hernia without the use of the knife, or by the taxis, are these:—

1. Before vomiting commences. It is evidence of sound judgment to abstain from manipulation of the tumor in this stage, and until other remedial means have been tried, except with the object of forming a correct diagnostication of its nature. The taxis, unassisted, often fails to replace the protruded viscus, and in many cases upon which we have been required to operate, patients have stated that the vomiting did not commence until after the use of prolonged and forcible pressure of the tumor. If the case be one of old and slowly-forming hernia, commonly reducible, which has become more painful and larger than usual, for a few hours only, the patient should be enjoined to lie on the back, the pelvis being elevated, and the knees flexed. Or, in other words, the abdominal muscles must be relaxed, by posture, as much as possible. Warm fomentations are to be disposed over the region of the mouth and neck of the sac, especially in children; and the tumor, if it be a scrotal hernia, supported, or never allowed to be pendant, thus dragging on the neck and mouth of the hernial sac by its own weight. The lower bowel may be induced to empty itself by administering an enema of warm water with a long flexible tube, and tincture of opium should be given in doses suitable to the age of the patient. It is desirable, however, that a full dose be given to adults: and with this view thirty drops diluted with camphor-mixture is not too large a quantity. A few hours may be allowed to pass away in order to afford time for this treatment to take effect, unless urgent symptoms arise.

[Opium may also be given in the form of suppository, with great advantage; one or two grains of the extract may thus be used at a time. The relaxing effect of the warm bath is also sometimes a valuable aid. Hot baths are recommended by some, but strongly deprecated by Messrs. E. Owen and John Wood (Brit. Med. Journal, Aug. 28, 1880). Cold baths are reported as successful in two cases by Hein (London Med. Record, Jan. 15, 1880).]

Some patients cannot maintain the posture just described, or it might be highly injudicious to enforce it. The principle of relaxing the abdominal muscles may then be carried out by allowing the patient to lie on the side of the trunk; but even then the hernial tumor must be carefully supported.

Under the influence of this treatment the patient very often falls asleep, and on awaking finds that the protrusion has returned into the abdominal cavity. Now, should that happy result not have occurred, it will be desirable to manipulate the tumor, gently, which perhaps has become soft and flaccid. This must be done upon some fixed principle. A successful issue will not accrue unless the pressure employed be directed with intelligence. The anatomical relations of the protrusion with the mouth of the sac and the apertures in the abdominal walls must be carefully considered; and the course or direction which the hernia takes in its descent should be strictly regarded in all efforts undertaken with a view to its reduction. The patient must be disposed in a posture to relax all the abdominal muscles which can in the slightest degree contract around the mouth of the sac. This part of the sac and its neck should be fixed, as far as practicable, with the fingers of one hand, whilst the fundus of the tumor

is held in the palm of the other. This proceeding can only be adopted when the tumor is large. The object desired by manipulator is twofold: first, to dilate the mouth of the sac; and, secondly, to diminish the bulk of the protrusion. The area of the orifice of the sac may be enlarged by employing the widest part of the body of the tumor as a fulcrum, over which the tissues composing that part of the sac may be stretched. If an enterocele be under treatment, the size of the protrusion may be dimininished by partially emptying the tube of its contents; perhaps by relieving the congested blood-vessels: and, in some cases, the tension of the sac is lessened by pressing the serous effusion it may contain into the peritoneal cavity. That fluid being thus disposed of, the operator is enabled to exert a more direct influence upon the hernia.

[Aspiration of the tumor has been many times found of the greatest use in diminishing the bulk of the protrusion, and thus promoting its return. The French surgeons have been especially outspoken in favor of this procedure.

M. Philippe (Med. News and Abstract, Aug. 1877, p. 367), advocates the use of muriate of morphia by hypodermic injection in the neighborhood of the tumor.]

2. During the stage of vomiting. It behooves the surgeon to be always on his guard in the use of the taxis, when vomiting is coincident with a hernial protrusion. The longer the time, indeed, the vomiting has lasted, the greater the risk in manipulating the tumor. If before the commencement of vomiting delicacy of handling be important, how much greater now is the necessity for gentleness when the state of the protrusion, as indicated by the symptoms, can be foretold! Before vomiting occurred, the tissues of the bowel were comparatively healthy, and the damage inflicted by pressure induced a morbid state. After vomiting, especially if it has been persistent some hours, and has become feculent, the tissues have been rendered morbid by the constriction to which they have been subjected. Ill-prepared, then, are they now to resist pressure, and the effect of violence will surely be to bruise or lacerate them.

The measures which were employed in times past to enable the surgeon to apply the taxis with more effect, and which were generally prescribed at this stage of a case of hernia, need no more than simple mention here. An exception may be taken in favor of opium. There is one period at which its administration is attended with decided advantage. After carefully watching cases of strangulated hernia, we believe we have correctly noticed that there is a short interval of repose which continues until regurgitation takes place from the small intestines. This occurs when the stomach is empty, as the result of vomiting two or three times. If this moment be seized, and a full dose of opium in solution, with a little stimulus, be administered, the hernia may sometimes be reduced by the taxis. But when once the vomiting of regurgitated fluids is an undeniable fact, the inward administration of medicines is pernicious.

We believe the statement to be correct, that all other modes of treatment have been abandoned in favor of the administration of chloroform.[1] Why? it may be asked. An analysis of the effects of those therapeutic agents formerly in vogue shows that they exerted an influence over the constitutional and local causes preventing the reduction of the hernia, similar to that which is now accomplished by chloroform more speedily, more certainly, with less risk to life, and under circumstances much more within control. The constitutional remedies were bleeding, the warm or hot bath, and tobacco-enemata; all of which exert a powerful but uncertain influence over the vascular, nervous, and muscular systems; on which account they cannot be employed without some risk arising from effects which are often uncontrollable and persistent for a longer period than is desirable. But the anæsthetic qualities of chloroform, together with the complete suspension of all voluntary muscular action induced by the inhalation of its vapor, renders this therapeutic agent of inestimable value, especially in those cases in which the abdominal apertures are under the influence of muscles controlled by the will, as well as stimulated to involuntary contraction by local irritation.

It is especially beneficial in all kinds of inguinal hernia. Its good effects are most striking in cases of hernia into the vaginal process of the peritoneum occurring in infants and youths, as also in those varieties developed slowly in adult life, and which have existed many years. In fact, the operation for the liberation of a strangulated inguinal hernia in middle age and elderly adults, is now rarely required in comparison with the frequency of its performance in past years. As soon as voluntary muscular contraction ceases, then the tumor gradually becomes softer or less elastic, under gentle and well-preconcerted pressure, smaller and of different shape, until at last the hernia escapes from the embrace of the mouth of the sac with a sudden jerk.

The sensation the surgeon experiences

[1 The reader may substitute the word ether for chloroform throughout this article.]

when it quits the sac and enters the peritoneal cavity is very peculiar and striking. So characteristic is this of the complete freedom of the bowel from constriction, that in its absence the expert surgeon immediately suspects that all is not quite right.

Usually vomiting ceases, after the reduction of the hernia, at once. Occasionally, however, it may continue from the effect of the chloroform alone; but the pain in the abdomen is immediately less, and quickly ceases altogether, especially that characteristic, dragging pain across the mesogastrium.

The patient should maintain the recumbent posture for a short time, with the abdominal muscles relaxed. We do not consider it necessary to place a pad and bandage over the mouth of the sac. Diet of a bland nature and semi-fluid consistence [such as milk or beef tea] may be allowed in small quantities, and all stimulation of the alimentary canal by aperient medicine must be avoided. As soon as the injured viscus has recovered its functions, the bowels will act spontaneously. Stimulants should be administered according to the constitutional depression existing at the moment.

But great caution as well as discretion are necessary qualifications on the part of the surgeon when he manipulates the tumor. During the insensibility of the patient, there is considerable risk of bursting the intestine or lacerating the hernial sac. For twelve hours, or even perhaps for twenty-four in old protrusions, after the first vomit, the danger of using the taxis with sufficient violence to burst the bowel is not very great; but so much damage may be inflicted on its tissues as to preclude all hope of the repair of the mischief. When twenty-four hours have expired, during which time the bowel has been strangulated, it may be very easily burst by forcible pressure, especially if during the latter part of that time the patient has been vomiting fluids which have regurgitated into the stomach from the small intestines. If there be hiccough, the taxis is inadmissible.

The indications of burst bowel are very characteristic. If an enterocele, the hernia glides away from the pressure of the finger, and consequently the tumor disappears. This act is not, however, accompanied with that sudden and peculiar sensation which the replacement of an unburst bowel within the peritoneal cavity produces. The patient immediately complains of severe pain in the abdominal region; vomiting ceases, but retching and hiccough may arise instead; collapse rapidly supervenes, and death closes the scene in a few hours. In some instances inflammation and suppuration have taken place in the sac, and, extending to its coverings, an intestinal abscess has been developed. A fistulous opening thus becomes established, which communicates with the interior of the alimentary tube. (See preceding remarks on Artificial Anus, p. 686.)

There is a period, then, "when the symptoms of the rupture have gone very far, that it is imprudent to reduce it, even if possible; but as it is impossible, perhaps, to tell when the mortification of the gut is gone too far for reduction, it will, in general, be attempted while life exists, with the hopes of a cure. Upon the other hand, it may be asserted, or supposed, that if it is not reduced, the person must also die; but this is not so certain as the other; for the mortification of a gut simply does not kill—it only kills from its consequences; and there is a material difference between a gut out of the belly, and one within. The consequence of one within is absolute death; but the one without in general endeavors at a cure, by producing inflammation and suppuration of the parts, which is producing a fistulous orifice, or artificial anus."[1]

Cold applications.—Considerable advantage attends the application of cold over the tumor. [Foster (Lancet, Aug. 27, 1870) reports two cases in which the application of cold water was successful in procuring reduction.] But when either ice or freezing mixtures are used, their action must be widely extended over the mouth, neck, and body of the sac. The local effects of cold are to diminish the bulk of the protrusion, by exciting contraction of its bloodvessels; to retard inflammatory processes; and, by reducing nervous sensibility, to permit an advantageous manipulation of the tumor. Frigorific applications are valuable agents when there may be unavoidable delay in obtaining chloroform, or in liberating the bowel from constriction. The moment for their employment is after vomiting has commenced, and we consider they are more suitable to cases occurring in the adult than in the earlier periods of life. The advantages attending their employment, however, are so trifling in comparison with the injury certain to be inflicted on the bowel by prolonged constriction, that it is safer to proceed at once to its liberation by operation, than to allow any great length of time to elapse in the expectation of an advantage, which is in any case doubtful. In practice, cold applications can only be regarded in the light of very useful prophylactics. After marked indications of strangulated bowel

[1] Hunterian MS. Cat. of the Mus. Roy. Coll. Surg. Eng., vol. iii., p. 117.

have existed twenty-four hours, cold as a local therapeutic agent is scarcely admissible, as a rule, on account of the delay which must necessarily occur at this important moment.

The distressing thirst, an accompaniment of continued vomiting, is greatly allayed by taking small pieces of ice into the mouth.

The introduction of every kind of purgative medicine into the stomach must be scrupulously avoided in all stages of strangulated bowel. When swallowed, they are usually speedily vomited; and therefore it is sometimes suggested that under these circumstances they cannot produce a bad effect. This, however, is not always the case. We have seen fatal results ensue from diarrhœa quickly supervening after the bowel had been reduced, the exciting cause of which was referable to repeatedly swallowing purgative medicines during the stage of vomiting.

A purgative enema seems to exert a beneficial effect occasionally. But after one has been used in the early period of the attack, a repetition of this treatment is perhaps hurtful in the majority of cases.

Many other local and constitutional remedies have been employed with the intention of assisting the reduction of a hernia, and with occasional benefit. But the uncertain result which attends their employment; the disease, which is always progressive in the herniated viscus; and the risk to life, a certain accompaniment of continued strangulation of the hernia, and its attendant consequences—deter the experienced surgeon from persisting in entertaining the hope of reducing the protrusion by the taxis, after chloroform has been fully administered, and the hernia remains unreduced.

[A case is recorded by Dr. Joy (British Med. Journal, May 13, 1876), in which a strangulated inguinal hernia was reduced by inflation of the bowels with air, pumped in by means of a common bellows, ether spray being at the same time applied, to chill the tumor.

Another case is reported by Mr. William Adams (ib., Dec. 26, 1874), in which a strangulated femoral hernia was reduced, after stercoraceous vomiting had lasted over three days, by very large injections of olive oil, castor oil, and oil of turpentine, into the rectum.]

Herniæ have been replaced whilst completely reversing the ordinary position of the trunk, by keeping the head nearest the ground and the pelvis upwards. A patient may be placed in this posture (head downwards) by hanging over the back of a man, or over the side of a high bedstead or sofa, whilst the knees are at the same time flexed. [See Am. Journ. of the Med. Sciences, April and July, 1874, January, April, and July, 1875.] Another method consists in encircling the mesogastrium with a folded sheet or round-towel, and at the same time drawing the contents of the pelvic region from below upwards, whilst the patient lies in a recumbent posture.

When the hernia is but recently strangulated, and it is an object to reduce it as speedily as possible, without a cutting operation, any method suggested which has been once successfully employed is perhaps worthy of a trial.

Injuries inflicted and accidents occurring in the use of the taxis.—These affect the following structures, separately or in combination; but we may consider independently—

Those affecting the hernia; those affecting the sac; and those involving the tissues covering the sac.

The hernia, whether consisting of a hollow or a solid viscus, may be bruised, and its bloodvessels ruptured. Under these conditions blood is extravasated into the tissues composing it, producing either patches of ecchymosis, or, when an enterocele exists, layers of effused blood appear between the different coats of the viscus.

The tissues of the bowel being most delicate, they are more commonly subjected to irreparable injury by violent taxis than the omentum. The presence of this structure, perhaps, often tends to prevent the serious mischief just described. The degree of irreparable injury inflicted on the bowel cannot be accurately estimated by the length of time the symptoms of strangulation have existed. Much rather does it depend upon the violence and prolongation of the attempts employed in the taxis. At any moment during the first twenty-four hours succeeding the first act of vomiting, the entire portion or coil of bowel in the sac may be so disorganized by pressure, that its vitality is entirely destroyed, and so literally killed, that nature throws off the part by the processes usually attending the separation of living from dead tissues. Under these circumstances, the entire calibre of the canal is divided, and an artificial anus is formed: or death takes place in consequence of extravasation of the stercoraceous material into the peritoneal cavity. Sometimes the tissues of the bowel are cut by pressure against the orifice of the sac, or the structures surrounding it; as in femoral hernia, against the free edge of Gimbernat's ligament. (See fig. 415.)

After the expiration of twenty-four hours, the constriction to which the bowel has been exposed having led to inflama-

tory effusion into and softening of its textures, there is great risk of bursting the tube. This rent usually occurs at the convex border of the gut, at the farthest point from the mesentery, and corresponds with the direction of the circular contractile fibres.

Another effect of violent compression is to cause the mixture of blood and coagula with the serum in the sac, and flakes of lymph or puriform effusion arise from the same injurious interference. The local and constitutional indications of these injuries have been described in a preceding page.

Injuries of hernial tumors by accidental violence.—We may here briefly describe the treatment of those injuries which happen to hernial tumors from accidental circumstances, during the pursuit of the ordinary avocations of individuals afflicted with reducible as well as irreducible ruptures. The reader will derive more information on this subject than it is possible to introduce here, by the perusal of a most interesting paper, entitled "On the Proceeding to be adopted in a Case of Injured Intestine from a Blow on a Hernial Sac," by the late Mr. Aston Key.[1]

A simple contusion is the mildest form of injury. Should the signs of more severe mischief be absent, the hernia may then be returned. It is important, however, that the patient abstain from bodily exertion, and the alimentary canal be kept in a state of repose. If the violence of the blow have been sufficient to cause inflammation and ulceration of the gut, the slightest indication of any such secondary mischief must be watched with the most anxious care, and the favorable moment seized when an incision into the tumor will allow the escape of the contents of the alimentary canal, and by this proceeding avoid the risk of extravasation into the peritoneal cavity.

But when there are plain indications that the primary effect of the violence has been to lacerate the intestine, which by chance was contained in the sac at the moment the injury was inflicted, time should not be wasted in adopting palliative measures; but the hernial sac must be freely cut open, and thus a ready means of escape be made for the stercoraceous fluids. The symptoms indicating a wound of the intestines are described in Vol. I., p. 908 et seq.—WOUNDS OF THE INTESTINE.

Another variety of injury of a hernial tumor is when the patient has an irreducible epiplocele. The omentum is adherent to the mouth of the sac, and entirely blocks it up, as it were, whilst the body of the sac remains as a simple closed serous cavity. A contusion of such a tumor excites inflammation and suppuration within the sac. Considerable embarrassment may be experienced in precisely diagnosticating the exact nature of the disease.

Injuries of the hernial sac.—There are two varieties of injury which produce important effects on the sac containing the hernia. Both of them render a case of strangulated hernia exceedingly complicated and embarrassing. The violence causing the mischief may be applied to the tumor either by the sufferer or by another person; but considerable force is requisite to rend or tear the tissues composing the sac, or to separate it from its surrounding connections. These injuries more frequently happen in association with long-continued pressure than after short trials of the taxis. The two varieties are as follows:—

A. *By displacement.*—The sac is detached, to a greater or less extent, from the surrounding structures. Those parts of the sac called the orifice and neck are more frequently affected by this injury than any other portion. They become detached from the inner surface of the internal abdominal fascia. Together with these, that portion of the parietal peritoneum immediately circumjacent to the sac's mouth is also severed from its attachments, and in this manner a pouch is formed within the fascial membrane of the abdomen, into which the hernia may be forced; and being retained therein, is lost to touch and sight. Sir Charles Bell has recorded a case which illustrates this injury.[1]

It is stated that the entire hernial tumor may be pushed within the abdominal walls, in a mass, whilst the hernia is still strangulated by the orifice of the sac. This injury was first described by French writers, under the appellation of "réduction en bloc." However, more recently, examinations made after death indicate other lesions to be the probable causes of the disappearance of the hernia, in some cases; and certainly afford conclusive evidence that such an accidental disposition of the sac, when strictly examined in an anatomical point of view, must still be regarded as a very rare occurrence indeed. We refer the reader to Mr. Luke's paper for further information.[2]

[Mr. Annandale (Edinb. Med. Journal, Feb., 1879), reports a case of reduction *en bloc*, in which a median incision

[1] Guy's Hospital Reports, 1842, vol. vii., p. 261.

[1] Lond. Med. Gaz., 1828, vol. i., p. 485.

[2] Med.-Chir. Trans., 1843, vol. xxvi., p. 159.

was resorted to, and the constriction relieved.]

In offering the following explanation of many of these cases, we court the inquiry of future observers, to support its correctness or to prove it to be erroneous. The tissues of the scrotum are very loose, and readily change their position. Every observer must have noticed the variable length of the spermatic cord, between the external abdominal ring and the testis, at different times. The hernial sac, attached to the anterior surface of the spermatic cord, also varies in length in like manner. When the hernia occupies the sac, the latter extends lower than when it is empty, in which last state it perhaps only just emerges from the inferior outlet of the inguinal canal. Now let its mouth and neck be detached from the internal abdominal ring, and the hernia, still strangulated by the margins of the orifice, be pushed inside the abdominal walls. The fundus of the sac attached to the tissues of the scrotum is not on this account severed from those connections, but merely ascends towards the inguinal canal, and lies partially within it with its walls in close contact, which, being rather thin, are not recognizable. The fact that this part of the hernial sac has been often found in this situation during the progress of an operation for the liberation of the strangulated gut, is attested by the reporters of those operations.[1]

B. *By laceration or bursting.*—As the effect of forcible and long-sustained compression of the hernial tumor, the delicate serous membrane of the sac is rent, burst or torn, and the hernia makes its escape through the aperture into the subserous connective tissue. Its course outside the peritoneal sac is advanced by continued pressure; and detaching the connections of the neighboring peritoneum, it forms for itself a pouch between that serous membrane and the internal abdominal fascia.

The part of the sac a little below its abdominal orifice or mouth, usually styled the neck, which lies in the inguinal canal, is most frequently burst along its posterior surface. This injury is more commonly produced in that variety of inguinal hernia, the sac of which is constituted of the vaginal process of the peritoneum, whether the hernia be in contact with the testis or not. It is inflicted with remarkable facility when the patient is fully under the anæsthetic influence of chloroform, especially if he be also youthful. This accident is easily imitated, after death, upon a subject in which the neck of the hernial sac happens to be rather long, by cutting an opening in its posterior wall, and pushing the finger in a backward direction. The course which the finger takes is that one which the hernia would pursue.

The indications of the accident having taken place are as follows: the tumor becomes flaccid, and therefore smaller, which alteration in its features is probably owing to the serum which the sac contained being squeezed through the rent into the connective tissue around the sac; the bulk of the tumor slowly diminishes as the pressure is continued, until at last very little, if anything, can be felt, but the surgeon has failed to experience that sudden jerk so characteristic of the escape of the hernia from the gripe of the mouth of the sac, as it enters the abdominal cavity; and if he have had much experience of the reduction of hernial protrusions, doubts will arise in his mind as to the probable direction this one has taken. After the effects of the chloroform have passed away, all the symptoms of strangulated bowel recur, and perhaps with increased force. Even the tumor itself may reappear, and recede on the application of slight pressure.

Now all these circumstances are highly characteristic of the accident that has occurred; and there remains but one proceeding to be adopted immediately. It is this. The hernial sac must be exposed and opened. Perhaps it may appear to be emptied; and even the finger passed upwards and along the inguinal division of the sac enters a cavity through a well-defined aperture, in which intestine is felt. This abnormal aperture may be mistaken for the internal ring and the cavity into which it leads, that of the abdomen. Acting upon this belief, however, would lead to the commission of a fatal error; one which, if not detected at the moment, will surely compromise the life of the patient. An effort must now be made to draw the bowel out, if it does not come forth spontaneously; and when this is accomplished, the true mouth of the sac will be discovered by passing the finger upwards along the anterior surface of the mesentery. By the orifice of the hernial sac the protrusion is firmly constricted. The constricting tissues, therefore, require to be cut; after which operation, the exercise of great care and caution is needed to prevent the entrance of the hernia once more into the abnormal space outside the peritoneal cavity. As the salvation of life depends upon the return of the protrusion through the natural orifice of the sac, considerable freedom in the use of the knife is justifiable, if the attainment of the desired end is thus facilitated, and the risk of failure in doing this thereby removed. All cases of

[1] Med.-Chir. Trans., 1859, vol. xlii.; see tables at end of paper, p. 278.

this description not only give rise to great embarrassment and difficulty, but they are also associated with very unfavorable consequences and results.

Injuries to the coverings of the hernial sac.—A very short description will suffice to indicate the nature and effects of the injuries inflicted on the tissues covering the sac by the use of unjustifiable violence in attempting to reduce a hernia by the taxis. We have seen the results of contusion; namely, ecchymosis of the integuments; extravasation of blood and œdematous infiltration into the subcutaneous tissues covering the sac; and inflammation of all the structures together, passing on to suppuration, sloughing, and phlegmon, extending to the neighboring regions. Those local morbid conditions require the ordinary topical measures suited to them.

The disappearance of the hernia in consequence of its passage from one sac into another;—intra-parietal.—We may here allude to those rare cases of inguinal hernia which are complicated with an intra-parietal sac. Anatomically examined, the hernial sac in these cases consists of two parts; that division which passes along the inguinal canal into the scrotum, and that one which is lodged in the walls of the abdomen. A full description of these curiously developed sacs is given in the section of this paper devoted to inguinal hernia. Now when the hernia is strangulated by the ventral orifice of the sac, and it occupies the scrotal division, it may be pushed by the taxis, even when employed with the utmost care and skill, into the other sac, and thus, the tumor disappearing, the surgeon considers the hernia reduced. The constitutional symptoms, however, quickly indicate that this is not the case. By inducing violent action of the abdominal muscles, or making the patient stand erect, the hernia will sometimes reappear. Under any circumstances, the liberation of the bowel is demanded, and in the necessary operation to accomplish this end great care is required to avoid passing the bowel from one sac into the other, instead of into the abdominal cavity.

[For cases illustrative of this, see Med. News and Abstract, May, 1879, p. 221; or London Med. Record, Feb. 15, 1879.]

The operation for the removal of the impediment to the reduction of the bowel, or the liberation of the hernia.—The culminating point in the treatment of every case of strangulated enterocele is reached when the impediment to the reduction of the bowel must be removed by a cutting operation. This of course occurs after the failure to reduce the protrusion by the taxis.

The part of the practical surgeon is not only to know truth, but to apply it; and, however repugnant to the feelings of the patient, or creative of alarm the thoughts of an operation may be, it is his paramount duty to urge concurrence in this step, as it alone offers the surest prospect of the salvation of life.

By too many medical men the cutting operation seems to be regarded in the light of a last resource, and one which it is improper to use until the danger to the life of the patient appears imminent. But the sooner this fatal error is eradicated, the sooner shall we discover upon what fallacious views it has been based. We believe that death resulting from strangulated bowel would be a rare occurrence, if it were practicable to return every strangulated enterocele within twelve hours after the commencement of the symptoms, even assuming that the cutting operation be required to accomplish that end in every case. For let this conviction be firmly impressed upon the mind, that death results not from the operation, but because the operation was not performed at the right moment.

Every medical attendant upon a case of strangulated hernia should reflect on these indisputable facts, that so long as the viscus remains in that condition the life of the patient is slowly ebbing; that to his judgment and foresight has been committed the safety of the sufferer; and that upon his discretion, firmness, and resolution hangs the fatal issue. For it is no exaggeration to say, that each minute as it elapses carries with it the chances of recovery further and further away.

We hope that the mortality arising from strangulated hernia is not now so large as it once was.[1] Nevertheless, at this moment it is excessive; and when we know, and all professing surgery should know, how surely the liberation of the bowel tends to save the life of the patient, why is it not done the moment all other measures have failed to replace the gut in the abdominal cavity? Some medical men do not seem to be sensible of, or to appreciate the vast amount of injury

[1] Mr. Hey states, that when he entered upon the profession of surgery, now 100 years since, "the operation for the strangulated hernia had not been performed by any of the surgeons in Leeds;" and he adds, that he "lost three patients in five upon whom the operation was performed."—Practical Obs. in Surgery, 3d edit., 1814, p. 129. Are the results of the treatment of strangulated hernia more successful at the present day? We fear not.

which is certain to accrue from the persistent vomiting, nor to value the indications derivable from the character of the vomit. They most assiduously attempt to check the vomiting by administering medicines; but they utterly reject, at the suitable moment, the only means by which it is to be arrested.[1]

The operation, kelotomy, herniotomy. The first part of the operation consists in cutting through all the tissues covering the hernial sac, carefully recognizing their characteristics as they differ in the special regional varieties of hernia. Having reached the sac containing the strangulated viscus, the operator now determines upon the propriety of opening it and exposing its contents to sight and touch.

If he determine to cut the sac open, it should be done in this manner. The body of the sac is nipped up between the finger and thumb, and with exceedingly great care, to avoid at the same time including the walls of the bowel. An opening sufficiently large to admit a grooved director is next made with a scalpel, the sharp edge of which must not be directed towards the contents of the sac, but laterally. The side of the blade should be placed nearly flat on the tumor. By this management of the instrument, all risk of injuring the intestine is removed. A grooved director having been passed through the opening and firmly held against the inside of the sac, rather indeed stretching its tissues over it, they are freely divided, upwards and downwards, or towards its orifice and fundus.

Usually the escape of more or less serum is a sufficient indication that the hernial sac has been opened. But the operator should not be thrown off his guard by an absence of serum, when the sac has been cut, any more than by seeing a flow of fluid when it has not been even reached. The latter somewhat rare occurrence is due to the development of a cyst upon the hernial tumor, and is at once explained by passing the finger into a circumscribed cavity. For the variable conditions of the serum, see page 687.

When an enterocele is under treatment, the intestine is brought into view as soon as the sac is opened; but in an entero-epiplocele it often happens that the omentum only is exposed. The surgeon then carefully raises this structure, for the bowel lies underneath it in the majority of cases. It is wholly enveloped by it in some instances, when that arrangement termed an omental sac exists. In this case the omentum requires to be carefully unravelled. We employ the last word in order to insure the use of much care and caution in the division of its tissues.[1]

The condition of the bowel should be now carefully ascertained, for by the morbid state of its tissues the surgeon determines upon the propriety of placing it within the peritoneal cavity, or allowing it to remain outside of the abdomen. Simple adhesions of the bowel to the body of the sac may be gently broken down; but the greatest caution is required in this treatment of the hernia where it lies within the orifice of the sac, as by rough manipulation its tissues may be torn, when extravasation of the contents of the tube into the peritoneal cavity will take

[1] We may have expressed our views a little strongly, and thus laid ourselves open to criticism and animadversion; for we confess to have been a little influenced whilst writing these lines by an occurrence which took place at the time of doing so. A fine woman for her age, which was seventy-one years, known to be the subject of strangulated femoral hernia, was allowed to vomit persistently for between ten and eleven days. At this time she was sent to the hospital "for the operation," which necessitated a journey of several miles. She arrived cold and pulseless, though intelligent; the abdomen was tympanitic; she was in fact moribund. As soon as practicable the liberation of the bowel was effected. The escape of purulent fluid from the abdomen was sufficiently characteristic of the condition of the peritoneal cavity. In spite of warmth applied to the surface of the body and stimulants administered internally, she expired in a few hours after admission. Yet, during the ten days preceding, medicines had been prescribed to arrest the vomiting, taxis had been frequently employed, and the marvel was, as a friend who accompanied her expressed it, that she reached the hospital alive. What other result than death could have been anticipated? *Ten days'* vomiting, and starvation for the same period, was surely enough to destroy life at the age of seventy-one years; but, in addition, she had a perforating ulcer at the point of junction of the upper division of the alimentary canal with the hernia, extravasation of stercoraceous matter, and diffused peritonitis. Nor is this case an isolated example of culpable negligence. Instances already recorded in books, and abundantly exemplified by reports in the weekly medical journals, abound in the metropolitan and provincial hospitals. Such misfortunes—for we deem it to be a misfortune that hospital surgeons have to treat cases of this kind—would never occur if the medical attendant could but be made to feel that his patient lies within the jaws of death until the intestine is returned into the peritoneal cavity.

[1] A very interesting paper on these "omental sacs," written by Mr. Prescott Hewett, is published in the Med.-Chir. Trans., 1844, vol. xxvii., p. 282; and another, on a case of scrotal hernia, with compound omental sac, in Path. Trans., vol. iii., p. 98.

place. If the bowel is ruptured, it must be confined to the edges of the wound by sutures.

To reach the impediment to the reduction of the hernia, the point of the index finger is now directed upon the anterior surface of the mesentery, towards the mouth of the sac. Should the end of the finger pass freely through the ventral orifice of the sac into the peritoneal cavity, when introduced with great gentleness, an attempt may be made to reduce the hernia without cutting this part of the sac. In the manipulation of the bowel great delicacy is required. The surgeon gently presses the distended coil, and if its fluid or gaseous contents escape into the continuity of the canal, it soon becomes flaccid. This condition may be regarded as an indication that the protrusion is reducible without cutting the orifice of the sac. On the contrary, if after delicate and continued digital pressure the knuckle of intestine continues to be tense, elastic, and round, the surgeon decides to enlarge the mouth of the sac by cutting it. Operators with little experience would do well to make use of a grooved director. This instrument is carefully passed upon the anterior surface of the hernia, its direction being guided by the index finger of the left hand. It should be introduced into the abdomen sufficiently deep to be entirely clear of the constriction formed by the tissues around the protrusion, but not further. Careful examination is necessary at this step, to ascertain that the bowel does not overlap the borders of the director, nor lie between it and the anterior region of the neck and orifice of the sac. To avoid all risk of injury to the bowel, when that viscus is quite clear of the groove in the director, the instrument should be firmly pressed against the tissues which are about to be cut. A bistoury, specially constructed for this operation, is gently glided along the groove on the director, and a slight resistance is usually encountered as it passes through the constriction, which, however, yields as the cutting edge reaches, and in its passage divides, those tissues which cause the impediment to the reduction of the hernia.

When those tissues are firm and rigid, a sound is produced, or a peculiar sensation is felt, on dividing them, resembling the cutting of thick leather. The operator now employs the index finger to examine the opening he has made. If it feels sufficiently large to admit the passage of the hernia, he next attempts its reduction; if it prove still too contracted, the bistoury may be passed along the finger and the incision increased. The impediment to the reduction of the hernia being thus entirely removed, its replacement within the abdominal cavity is easily effected.

The following, then, are the principles upon which every step of the operation must be based: minute anatomical knowledge; the exercise of deliberate consideration and judgment; the recollection of the necessity for practical care, and for delicacy of manipulation, and of the importance of interfering as little as possible with the surrounding structures. Just so much must be accomplished as is absolutely needed, and no more.

But we must revert to a few subjects merely alluded to in the preceding description of the operation.

Of opening the hernial sac.—When the anatomical relations of the hernial sac were carefully examined, it was discovered that the impediment to the reduction of the hernia was not in all instances caused by the narrow passage of the ventral orifice of the sac alone. Careful dissections showed that those structures which lie in close connection with the outside of its mouth and neck offered considerable obstruction to the retrograde passage of the hernia through those parts of the sac.

For the last hundred years surgeons of eminence have applied these anatomical facts to treatment, and many distinguished operators have dwelt upon the advantages to be derived from replacing the hernia in the abdomen without cutting open the peritoneal sac. On the grounds above alluded to, they have devised that mode of performing the operation for a strangulated enterocele called "the division of the stricture without opening the sac," or "external to the hernial sac."

The advocates of the operation believe its most favorable points to be as follows: the peritoneal cavity is not opened; the peritoneum at the mouth of the sac is not cut; the diseased intestine is not exposed to the influence of the atmospheric air, nor to the direct contact of the fingers of the operator; nor is the risk of hemorrhage into the peritoneal cavity so great, should a large vessel be accidentally cut. They consider, then, that the operation itself is not attended with the same amount of danger as when the peritoneal cavity is opened, its parietal reflection cut, and the inflamed bowel exposed.

The simplicity of the proceeding commends the operation highly; for the wound inflicted is very little more than an incision through the integuments, and its advantages must have seemed paramount at a time when the dangers of the operation were exaggerated, and it was

assumed that patients with strangulated hernia died from the effects of the operation itself.

Bearing in mind, however, that death occurs from the constitutional and local effects of long-continued strangulation of the bowel and its injury by forcible taxis, and because the bowel is not liberated by the operation early enough, the advantages of any particular mode of operating, especially of this one, are perhaps not quite so great as at one period many surgeons were inclined to admit. The method of performing the operation is quite a secondary consideration, in comparison with the importance of the early liberation of the bowel.

The opponents of this operation enforce their objections with the doctrine that, when the necessity arises for any cutting operation at all, the fact alone is sufficient to demand an incision into the hernial sac, in order to ascertain the cause of the impediment to the reduction of the hernia; and that an operation for the liberation of a strangulated bowel is not complete until that viscus has been carefully examined. They also regard the risk to be great of reducing the hernia, still strangulated by adhesions, omentum, or even by the orifice of the hernial sac itself.

Next, pointing to statistical facts, and comparing the results of the two operations as performed in different metropolitan hospitals,—in those where the preference is given to opening the sac in all cases, and in those in which the opposite plan is pursued,—they maintain that the greatest success is obtained at those institutions where the sac is incised as a rule.

It is, however, quite clear that we are unable to collect any facts upon which to institute a safe comparison. Conclusions as to the success of the one practice or the other, based upon the results of the cases under treatment, in the hospitals, are really worthless, because the incidents in any two cases of hernia are never precisely alike, and accuracy as to details, which is absolutely required to arrive at the truth, cannot be obtained.

We believe the dictum to be equally erroneous, when one surgeon says that in every case the sac must be opened, and another directs that it must not, except by compulsion. The proper practice consists in making a judicious selection of the cases: viz., those in which the operator opens the sac upon a fixed principle; those in which he does not, because, according to his judgment and experience, there is no necessity to do it.

In many of the metropolitan hospitals the operation external to the sac is performed in suitable cases, upon conviction of its advantages; and although we dare not venture to say that some of the fatal cases which have occurred after opening the sac might have terminated differently had it not been incised, we do not hesitate to affirm, that the untoward circumstances stated as likely to happen, when the sac is not opened, have not occurred.

Doubtless every hospital surgeon, to whom the opportunity occurs of frequently operating on cases of strangulated hernia, will be guided by his own judgment as to the propriety of opening the hernial sac in every case, or of leaving it intact in selected cases. But if we may be permitted to enunciate the principle upon which inexperienced surgeons may act with safety, it would be this. In all those cases in which the surgeon would deem it safe to return the hernia by the taxis, if it were practicable, he may do the same thing after he has removed the impediment to the reduction of the hernia, by cutting those tissues lying outside the sac which are the cause of that impediment. But in those cases in which the symptoms are suggestive of an aggravated morbid condition of the bowel, and on account of which it would be improper, nay hazardous, to attempt to reduce it by the taxis—in those the sac must be opened.

In making a suitable selection of the cases for the first plan, great discrimination is therefore required. We regard those cases to be favorable for the operation in which the symptoms of strangulation have existed but a few hours, and when they have not been very severe; when the vomiting is not stercoraceous, nor the patient very prostrate; when the tumor is a simple enterocele, and when it has escaped forcible attempts at reduction. Of course no cutting operation of any kind will be attempted until after the failure of well-applied taxis to reduce the hernia.

On the contrary, the indications for incising the sac are: a long continuance of the strangulation of the hernia; inability to empty the sac completely; the persistence of stercoraceous vomiting; the prostration of the patient; the compound conformation of the tumor (it being an entero-epiplocele); and after repeated, protracted, or forcible taxis has been used.

Guided by these facts, the number of cases in which the operation of division of the impediment to reduction of the hernia external to the sac may be regarded as preferable to any other, becomes very limited. But we cannot refrain from expressing our conviction, founded upon the results obtained in those cases in which this operation has been carried out, that it is easy of performance, free from the risks attributed to it, unaccompanied by some of those accidents which occasionally occur when the sac is opened, and most favorable to the rapid recovery of

the patient. It must, however, be remembered that these are select cases, and belong to a class most favorable for recovery; and we cannot deny but that they would probably be successful, even should the peritoneal sac be cut open.

Nevertheless, the inquiry suggests itself, If the hernia can be reduced with safety without opening the peritoneal cavity, why should it not be?

Of the instruments required to perform the operation.—They are as follows:—

1. An ordinary scalpel, with a single cutting edge.
2. Forceps.
3. A grooved straight director.
4. A grooved director, specially adapted for insertion beneath the tissues forming the impediment to the reduction of the hernia.
5. A bistoury of peculiar construction, with which to cut those tissues.
6. Retractors.

The *director* (4) and the *bistoury* (5) are the only instruments requiring special notice.

The *director* has been constructed after a great variety of forms—straight and curved; long and short; narrow and wide; with wings or lateral projections to protect the bowel from the knife; with and without a handle affixed; with a probe-pointed end or beak, with the

[Fig. 416.

Hernia-director.

Fig. 417.

Levis's hernia-director.

Fig. 418.

Cooper's hernia knife.]

groove terminated, near the end, by a stop, or without such a stop. That form of the instrument invented by the late Mr. Aston Key has been employed under our observation many years with advantage; and we are able, therefore, to recommend its use. It is usually known as Key's hernia-director.[1]

The *bistoury* used to divide the tissues which constitute the impediment to the reduction of the hernia, wherever they may be situated, has been made in a great variety of shapes, lengths, and breadths, and usually with some contrivance, movable or fixed, to prevent its end and cutting edge injuring the intestine. It being impossible to describe every variety of the instrument, perhaps it will suffice to state the characteristics of a good one for safely performing this important part of the operation. It is desirable to have two bistouries at hand; one straight, the other curved. When the ventral orifice of the sac is deeply seated, the latter will be found very useful. In other particulars the two instruments resemble each other. The metallic part extends about $3\frac{1}{2}$ inches beyond the handle. Its sides are $\frac{3}{8}$ of an inch broad where it unites with the handle, and they gradually taper towards the end, where the breadth is $\frac{1}{8}$ of an inch. The blade terminates in a button or blunt end. At the terminal $\frac{3}{8}$ of an inch, the sides of the metal are bevelled off, and one edge is made to cut. This sharp edge should be slightly concave. All the other edges and surfaces of the metallic shaft are carefully rounded off and polished. Sir A. Cooper's hernia-knife has a cutting edge $\frac{6}{8}$ or $\frac{7}{8}$ of an inch long, beyond which extends a blunt terminal portion $\frac{3}{8}$ of an inch long. The objection we entertain to this knife relates to this long blunt beak, which must be passed into the abdomen before the cutting edge reaches the tissues which require division.

When the index finger, of either hand most convenient to the operator, is employed as a director, its point is passed

[1] A drawing representing this instrument may be seen in Mr. Key's Memoir on the Advantages and Practicability of dividing the Stricture in Strangulated Hernia on the outside of the Sac, 8vo, London, 1833; Drawing 1.

to the orifice of the sac, outside or inside; the bistoury is passed upon the anterior surface of its first phalanx, and the side of the instrument being pressed against it, lies in a depression on its soft parts. Thus the sharp edge of the knife is prevented from injuring the bowel. The end is then dextrously insinuated beneath the tissues to be cut; and as they slowly yield before it, the finger follows the direction of the knife, and the operator judges of the size of the opening he is making by the facility with which his finger passes into the abdomen.

When a metallic director is used, the bistoury is gently carried along the groove of the instrument.

Of the treatment of the strangulated intestine.—The primary object of every surgeon who has a case of strangulated enterocele under his charge, should be the return of the intestine into the abdominal cavity as quickly as possible. With this object in view, "the operation," as it is termed, is undertaken after the failure of all other means.

But there are certain morbid states of the bowel which preclude the operator from doing this, after the liberation of the viscus from the constriction to which it was subject. The morbid conditions having been already described (p. 684), we need only briefly refer to them here, in order to direct their treatment.

Commencing, then, with the worst condition, in which the entire knuckle of the intestine in the sac is dead, mortified, or sphacelated. Before the operation, adhesions will have formed between the coils of bowel in the abdomen, as well as between them and the parietal peritoneum in the vicinity of the margins of the mouth of the sac. It would be very injudicious interference with the processes of nature to break down these adhesions. They are the result of peritonitis; and this form might be termed protective, for its effects, especially the adhesions, may possibly prevent the extension of the peritonitis, and the mischief which would certainly accrue if the contents of the alimentary canal escaped into the peritoneum.

It is sometimes difficult to find the end of the upper portion of the alimentary tube, from which the stercoraceous matter escapes; meddling with the processes of nature is not desirable, and therefore, unless the perforated viscus is easily reached, it is better to leave the parts as they are, exposed. The edges of the wound should be left free and open, in order to allow a ready escape for the contents of the bowel. In this manner an artificial anus is established. (See fig. 414.) Should the open end of the gut be accessible, one, two, or more sutures may be inserted through all the structures constituting its walls, and they may be thus fastened to the integuments.

If there be a small perforation in any part of the herniated viscus, the result of disease, there are generally adhesions within the abdomen, which prevent the extravasation of its contents into that cavity. When, therefore, the opening does not involve the whole calibre of the canal, the herniated viscus may be placed just within the abdomen; for sometimes the aperture will entirely close, even after stercoraceous matter has freely flowed through it for several days. Even a ligature may be tied around a small hole in the intestine with the best results. This treatment was successful in a case reported by Dr. P. H. Watson, of Edinburgh.[1] (See fig. 413.)

Should the intestine be accidentally wounded, the cut edges may be carefully drawn together by using the glover's suture, and returned just inside the mouth of the sac.

When the tissues of the herniated bowel are not perforated, but appear to be in such a morbid condition as to induce the operator to fear that their restoration to a healthy state is improbable, although just possible, the hernia may be returned if the adhesions at the neck of the sac are not strong. The late Mr. Aston Key advocated this plan of treatment. He did this upon the principle that the abdominal cavity was the place in which the injured bowel was more likely to be repaired than in any other. "The danger of abdominal extravasation will not be increased by replacing the injured bowel at the neck of the sac; for, should sloughing of its coats ensue, the slough may be walled-in by adhesion of the surrounding peritoneum, and fecal extravasation be prevented."[2] When adhesions prevent this treatment it is better to divide the orifice of the sac slightly, and to leave the bowel in the sac. Under such unfavorable circumstances, patients occasionally recover without a fecal fistula. An interesting case of this kind is published by Dr. Watson, in the Edinburgh Medical Journal, March, 1870.

In some cases the operator encounters great difficulty in reducing the hernia, even after the mouth of the sac has been freely enlarged. This depends upon the following causes:—

1. *Its bulk.*—The hernia sometimes consists of a very large quantity of intestine, which is distended with flatus; and although a portion is reducible, the reduc-

[1] Edinb. Med. Journ., July, 1869.

[2] Guy's Hospital Reports, 1842, vol. vii., p. 264.

tion of the entire mass is impracticable. After the failure of these attempts, a plan may be pursued which was adopted by Mr. Tatum with complete success.[1]

The bowel may be punctured, and the flatus allowed to escape. Mr. Tatum used a grooved needle for the purpose; we would suggest the employment of the filiform trocar and canula. This instrument may be obliquely inserted through the tissues of the bowel, thus forming a valvular wound.

2. *Adhesions.*—These may be *recent* or *chronic*. The latter are often formed long antecedent to the conditions for which the operation was undertaken. In the recent state the adherent surfaces are usually easily separated, whether they unite the coils of the bowel to one another, to the sac, or to the omentum. When this morbid condition happens to the viscus *in* the body of the sac, there is not much risk of the interference making mischief; but when the bowel is adherent to the mouth of the sac, the condition usually indicates an advanced morbid state of the viscus. It is an indication that nature has made preparations to prevent extravasation into the peritoneal cavity, in the event of the bowel bursting from the distension caused by accumulations in that part of the digestive tube above the hernia. Meddling with such adhesions is attended with great risk of tearing the bowel. The safest procedure is to reduce the protrusion, if possible, after having enlarged the mouth of the sac; but even allowing it to remain in the sac, relieved from constriction, would be preferable to lacerating the bowel in the attempt to separate the adhesions, and so establishing an artificial anus. Recent adhesions to other structures may be separated with ease. Flakes of adherent lymph had better be left where found. By detaching them, the coats of the bowel may be torn; and they frequently overlie small sloughs.

Enteroceles of long standing sometimes become permanently united to a part of the sac, although very rarely. In such cases the orifice of the sac is usually large, and the chance of the bowel becoming strangulated proportionally remote. The peristaltic action of the canal proceeds as usual in the hernia, with occasional inconvenience arising from accumulations therein causing obstruction. Should an operation be required, one of two proceedings may be adopted: either the orifice of the sac may be enlarged, and the intestine left in the sac; or the adhesions of the viscera may be destroyed, and the bowel returned. The choice between these two plans might be decided by the condition of the viscus and the extent of the adhesions.[1]

3. *The depth and inaccessibility of the mouth of the sac.*—That part of the sac which lies in close relation with the general peritoneal cavity is sometimes so deeply seated, that considerable embarrassment arises not only in making its orifice larger, but in returning the hernia into the peritoneal cavity when that has been done. By employing an assistant, who carefully holds the opened hernial sac by its cut edges, to draw it forwards and outwards, or from the abdomen, its mouth is more fixed and slightly stretched. This manœuvre greatly facilitates the reduction of the protrusion.

Treatment of the omentum.—Omental protrusions or epiploceles rarely require the removal of the impediment to their reduction by a cutting operation. But after the return of the intestine, in cases of entero-epiplocele, it often becomes a question, what is to be done with the omentum.

The treatment is as follows: it may be reduced; it may be left in the sac; it may be cut off; or a ligature may be tied around it.

The first proceeding would be generally chosen when practicable. In some instances, however, the great bulk of omentum, or its diseased condition, necessitates a choice between either leaving it in the sac or removing it.

There are some disadvantages in leaving the omentum in the sac: the fat becomes inflamed; it suppurates, and sometimes sloughs; the healing of the wound is consequently delayed, and the after-treatment of the case thereby protracted. Usually, however, the omentum shrinks up and contracts, and eventually the wound heals, but with more or less of a tumor at the abdominal aperture. This swelling may interfere with the successful application of the pad of a truss. Some surgeons, however, believe the remains of the omentum to be useful in blocking up or plugging the ventral aperture.

The removal of either the whole or a part of the protruding omentum may be effected by cutting it away at once, or by applying a ligature around it near the orifice of the sac, and leaving the portion below the ligature still attached, or cutting it off. Besides, there is the alternative of leaving the truncated end of omentum in the sac, or of replacing it in the abdomen. By the exercise of due care, omental adhesions to the sac may be

[1] See INJURIES OF THE ABDOMEN, Vol. I., p. 905.

[1] Relating to these cases, the reader may consult A Treatise on Obstructed and Inflamed Hernia, by Henry Stephens.

safely separated, whether recent or chronic.

If the omentum be cut off, there is great risk of bleeding from its cut vessels when it is replaced in the peritoneal cavity. Even after every precaution had been taken to secure the bloodvessels, cases in which omentum has been excised have proved fatal from internal hemorrhage alone.

It has been assumed by some writers to be injudicious to tie a ligature around the omentum, on account of the untoward results which may ensue. But the reader should refer to Vol. I., p. 904, where he will find the good results of this plan of treatment related by Mr. Pollock, as well as the mode of applying the ligature.

By the kindness of the editor, Mr. Holmes, we are able to give the result of the practice of removing diseased or superfluous omentum, after ligature, as performed at St. George's Hospital. Of twenty cases of hernia in which the omentum was securely tied, a few died; but the notes of the after-death examination of them show the cause of death to have been, in all cases, independent of the ligature placed around the omentum. Of eleven cases in which the omentum was allowed to remain in the sac, many recovered, although abscess and sloughing of its tissue occurred in some of them.

We are informed that in no single instance has any untoward symptom been excited by the ligature of the omentum; and that the truncated portion of omentum filling the orifice of the sac plugs it, and produces a permanent obstruction to the descent of a hernia, quite as completely as when the whole mass is left. The period occupied in the cicatrization of the wound, seemed also to be shorter in the cases in which the omentum was removed, than in those in which it was not.

Cases of double hernia.—In patients suffering with a protrusion on both sides of the body, or in different regions, it is sometimes difficult to ascertain which hernia is strangulated. The surgeon must, of course, employ every means to arrive at a correct diagnosis before commencing the operation. But should he unfortunately have arrived at an erroneous conclusion, and having opened the sac of one hernia find no impediment to its reduction, nor indication of a strangulation, is he justified in cutting open the sac of the other? Certainly. And as a precedent, we may refer to a case in which M. Dupuytren performed a double operation, and saved the life of the patient.

A man, aged forty, was the subject of double inguinal hernia. A surgeon with much difficulty reduced both tumors. Well-marked symptoms of strangulated bowel existed, although there was no tumor at either ring. M. Dupuytren opened the right inguinal canal first, because the patient complained of most pain when pressed on that side. The sac was empty. He next opened the left inguinal canal and found a hernial sac containing an entero-epiplocele. The orifice of the sac was very deep; it was cut; the bowel returned; and the patient recovered.[1]

Treatment of the case after the operation.—The immediate effect of the reduction of the hernia is usually the cessation of vomiting, especially if the bowel had not been strangulated a very long time, and neither peritonitis nor hiccough had existed before the operation. After the employment of chloroform [or ether], however, the sickness and nausea induced by the anæsthetic will sometimes continue, when the treatment must be modified accordingly.

Another most striking result of the replacement of the bowel in the peritoneal cavity is the rapid relief from pain across the mesogastrium.

It is manifest that no single plan of treatment, to the exclusion of every other one, can be urged as applicable to all cases of hernia, after the liberation of the bowel. As the disease occurs at every age, in every variety of constitution, and under individual peculiarities of the most diverse kind, so strangulation of the hernia may happen with the idiosyncrasies and opposite conditions of youth and senility, strength and decrepitude, health and disease, temperance and intemperance. It must, however, be carefully borne in mind, when treating a case of this kind, that we have to deal locally with an injured intestine, and a penetrating wound of the abdominal cavity; and that the constitutional powers of the patient are greatly reduced by continual vomiting, starvation, suffering, and alarm.

In some youthful, robust patients the tendency to inflammatory action becomes, at an early period, strongly developed, whilst, on the contrary, in the aged and decrepit little disturbance may appear demanding interference.

The after-treatment has been conducted upon the most opposite principles. Surgeons of the highest eminence may be found amongst the advocates of the two methods, which may be briefly stated as follows:—

In one class are those who administer purgative medicines almost immediately after the operation, and persist in their continuance "until the canal is completely unloaded." Calomel, extract of colocynth, sulphate of magnesia, and

[1] Leçons orales, edit. 1832, t. i., p. 583.

castor-oil, are given by the mouth, or aperient enemata injected into the rectum.

Another class, relying almost entirely upon the restorative powers of nature and the influence which repose exerts on the reparation of injured tissues, depends upon diet, and, when required, opium.

In selecting one of these plans of treatment for adoption, we give the preference to the last, since it seems to be most suitable to the majority of the cases occurring in hospital practice. In many cases we have allowed the patient to recover without giving any medicine whatever; great care, however, being taken that a mild and farinaceous diet, with milk, be only sparingly taken.

This necessity for repose, writes Mr. Key, in an injured state of the bowel it would be well to bear in mind, after the operation for strangulated hernia. The bowel is gorged by the strangulation, bruised by the taxis, as it is too often practised, or inflamed by long incarceration in the sac. An intestine in such a condition cannot but be injured by an early administration of purgatives, which irritate and inflame the bowel, or exhaust what little remains of vital energy. After the operation, some time for repose should be allowed before the bowel is called into action; the surgeon's anxiety to procure stools should yield to the evident necessity for time being allowed for the restoration of the natural powers of the injured bowel.[1]

Great advantage is sometimes derived from the effects of thirty drops of the tincture of opium, which may be given with a little brandy-and-water, or camphor mixture, soon after the operation.

The bowels are often relieved spontaneously a few hours after the reduction of the hernia; but when they are obstinately inactive, the question arises of the necessity of giving aperient medicines. We have embraced abundant opportunities of comparing the advantages to be gained by the use of purgatives, and by abstaining entirely from their employment. We give the preference to the latter plan, but if the lower bowel becomes loaded, and any discomfort arises from accumulations therein, an enema of warm water, or gruel with common salt or a little castor-oil, or even sweet-oil, mixed with it, produces the desired result. Cases under our treatment have progressed favorably, and even the wound has healed, before the bowels have been relieved, and not the slightest trace of inconvenience occurred from the constipation.

When there is much tenderness on slight pressure upon the abdomen, in the neighborhood of the wound, the local application of leeches is of great service, and it may be repeated as often as required, but in relation to the powers and condition of the patient.

If acute peritonitis be developed, the treatment must be in accordance with the ordinary rules for the treatment of that disease.

Stimulants are often required soon after the operation, and should be given in small quantities. Indeed it is a rule which requires to be enforced, that all aliment must be given in very small quantities, and repeated at short intervals.

If thirst be distressing, pieces of ice placed in the mouth afford great comfort.

Treatment of the wound.—The structures which have been cut and disturbed by the cutting operation should be placed in relation to each other, and the divided edges of the integuments brought together by sutures. The number required may be left to the discretion of the operator, but no more need be used than sufficient to keep the upper two-thirds of the wound united. For it is always advantageous to leave an opening at the lowest end to allow of the escape of blood and discharges. A piece of wetted or dry lint may be laid over the incision, and a pad of folded lint is adjusted over it with a bandage by some surgeons. However, a bandage is not required in every case, nor is it on any account essential.

If, during the subsequent progress of the case, the connective tissue in the wound, the omentum, or the hernial sac should inflame, the appearance of the integument soon betokens that union by adhesion is hopeless. In that case the lowermost sutures, or all of them, must be removed, and the treatment to be adopted need not differ from that commonly employed in every inflamed, suppurating, or sloughing wound. The grand point is to keep a channel open for the free escape of the discharges.

The prognosis of a case of strangulated hernia.—Reflection upon the facts already described will enable the surgeon to form a very nearly accurate prognosis of a case of strangulated hernia. But in order to concentrate the attention of surgeons upon those incidents which more especially cause a fatal termination, we must briefly recapitulate the most important morbid conditions which call for special observation.

1. The condition of the tissues of the herniated viscera, and especially of the intestine. Their morbid state is too frequently produced by violence in the use of the taxis, by long-continued constric-

[1] Guy's Hospital Reports, 1842, vol. vii., p. 263.

tion, or by very tight strangulation of short duration. In such cases, then, the prognosis is usually unfavorable on account of the destruction of the portion of the bowel injured, or of its inability to repair the damage inflicted upon it.

2. The morbid state of the peritoneum, visceral and parietal, and of the tissues of that portion of the track of the alimentary canal between the stomach and the hernia. The existence of peritonitis antecedent to the liberation of the bowel cannot be regarded in any other light than as a symptom of grave significance. Associated with it, the alimentary canal above the hernia is usually greatly distended, and its contractile fibres appear to lose their function. These circumstances add to the unfavorable prospects, and lessen the chances of recovery in a very marked degree.

3. The impaired functions of the nervous system. Many patients sink away in the stage of prostration alone. This state of the nervous system is induced by long-continued vomiting, starvation, pain, suffering, exposure, neglect, journeying, purgative medicines, some medicated enemata, the hot or warm bath in some instances, and other measures supposed to facilitate the reduction of the hernia by the taxis. When great prostration, therefore, precedes the reduction of the hernia, it must be regarded as a most unfavorable indication.

4. Neither should we overlook the chronically morbid states of the viscera of the thorax and abdomen, irrespective of the hernia, so commonly existing in the class of persons admitted into our hospitals. Over the influence of these conditions, however, we can exert but little control, although they form an important element in prognosticating the issue of any case.

5. All these conditions are also influenced by the age of the patient, social habits, general cachexia, and individual idiosyncrasies—features in a case to which due attention must be given.

Now the lesson that we learn from the study of those morbid states which bring about a fatal termination is this: To return the herniated viscus into the abdomen as quickly as possible; to accomplish this with the utmost delicacy of manipulation consistent with the requirements of the case; to distinguish carefully between those cases in which no delay is admissible in liberating the bowel without the loss of a moment, and those in which some means are justifiably employed to assist the taxis. By acting thus energetically upon sound principles; by remaining at the bedside of the patient, or at least not leaving the case until the risk of danger is averted by reducing the intestine, the surgeon may hope to rescue from death a very large majority of the cases of strangulated hernia.

The high mortality arising from strangulated hernia is an opprobrium upon the medical art which cannot be removed by any amount of skill or dexterity displayed by the operating surgeon. The risk of the operation, the mode of its performance, and the subsequent treatment of the case, are merely secondary considerations when compared with the treatment to which the patient is subjected before the operator is called upon to perform his part. All matters relating to the operation only have, perhaps, reached perfection; but it would really appear, from the condition in which patients are sent into the hospitals to be operated upon, that the greatest amount of ignorance prevails of the principles upon which an irreducible hernia should be treated.[1]

PART II.

Special Kinds of Hernia.

The following classfication of abdominal ruptures is arranged with regard to the anatomical divisions of the abdomen in which they appear:—

[1] Twenty patients who died after the operation had been performed by the author in Guy's Hospital survived the operation as follows:—

1 only 17 hours.					
5 survived 24 hours and less than 48 hours.					
4	"	48	"	72	"
1	"	72	"	96	"
1	"	96	"	120	"
3	"	144	"	168	"
1	"	168	"	192	"

3 survived longer periods, but with artificial anus.
1 died of bronchitis.

The causes of death were—

Artificial anus, etc., in	3
Prostration in	5
Acute peritonitis in	8
Perforation of bowel in	1
Bronchitis and cachexia in	2
Neglect to seek surgical aid in	1

There can be little doubt that the lives of at least two-thirds of these patients were sacrificed by the delay in having recourse to the operation for the liberation of the bowel; which, however, was performed as soon as possible after admission.

I. In the EPIGASTRIUM
1. Diaphragmatic.
2. Epigastric.

II. In the MESOGASTRIUM
1. Ventral (also in other regions).
2. Umbilical.
3. Lumbar.

III. In the HYPOGASTRIUM
A 1. Above Poupart's ligament; inguino-scrotal; or labial.
B 2. Below Poupart's ligament; femoral.
C 3. Through the apertures of the pelvis; in front—beneath the ramus of the pubes, obturator.
4. In front—beneath the arch of the pubes, perineal.
5. Pudendal.
6. Vaginal.
7. Behind—through the ischiatic notch, ischiatic.

HERNIÆ IN THE EPIGASTRIC REGION.

Diaphragmatic hernia.—Of these cases there are three kinds:[1] first, that in which the diaphragm muscle becomes stretched in consequence of a loss of tone, and is pressed up into the thoracic cavity by the contents of the abdomen; secondly, that in which, in consequence of congenital defect, some of the viscera pass through the aperture into the thorax; and, thirdly, when some of the abdominal viscera pass into the chest through the natural apertures in the diaphragm, which have become stretched.

Epigastric hernia escapes in the angle bounded by the cartilages of the first false ribs, the apex of which corresponds to the appendix of the xiphoid cartilage. M. Malgaigne has seen an infant with a tumor in this region which swelled up every time any effort was made with the abdominal muscles. The sac of this hernia is generally more movable than that of an umbilical, and the mouth through which the hernia enters it is usually large. The reduction of the protrusion is therefore easily effected. A suitable bandage is required to prevent the escape of the hernia, which sometimes consists of a portion of the stomach, or arch of the colon and omentum.

HERNIA IN THE MESOGASTRIC REGION.

Ventral hernia.—Of this hernia there are two kinds: first, those which occur in the linea alba; and, secondly, those which pass through other parts of the parietes, except the so-called rings.

Those of the first kind usually escape in the linea alba between the umbilicus and the pubes. They are produced as the consequence of general relaxation and stretching of the fibrous tissue in the middle line of the abdominal walls, after they have been greatly distended during pregnancy or ascites. We have seen hernia consecutive to an abscess in which the pus had made its way through at the linea alba. This kind of hernia is more common than the second, which escapes through any part of the anterior or lateral walls.

The usual indications of a rupture accompany these kinds also; the chief risk of an error of diagnosis arises where circumscribed collections of pus exist in the parietes without much local pain or any constitutional disturbance. If the hernia be reducible, the surgeon would not be likely to fall into error; and if not, the history of the case, with a careful manipulative examination, will enable him to form an accurate diagnosis.

Umbilical hernia.—By this term we understand that kind of rupture which escapes from the abdominal cavity, either through the umbilical ring in the fœtus, or by an aperture formed at a later period of life in consequence of a separation of the fibres of the linea alba in the umbilical region. (See fig. 426, p. 731, in which a small one is delineated.)

The synonyms are, exomphalos, omphalocele, or, in common language, ruptured navel.

It is developed at all periods of life, and in both sexes. Most commonly observed in infancy, it forms a protrusion either before or soon after the separation of the umbilical cord. In youth it is rarely developed, provided that the umbilical aperture has been once well closed. As years advance, it is more frequent, especially in females, and particularly so in persons disposed to obesity.

The hernial sac is always an acquired formation in this rupture; that is to say, there is not any peritoneal extension at the umbilical ring, in fœtal life, analogous to the inguinal vaginal process of the peritoneum. Nevertheless, writers have

[1] Exclusive of cases in which the abdominal viscera pass into the chest through a laceration in the diaphragm. Such cases are treated of under INJURIES OF THE ABDOMEN, Vol. I., p. 892.

been long accustomed to divide this hernia into the congenital variety, or that which is so common in infants; and the acquired, or that variety which is developed in after-life.

In infants the protruding viscus pushes before it that portion of the parietal peritoneum lying immediately behind the aperture in the linea alba, through which the umbilical vessels enter the abdominal cavity. The hernial sac is thus formed before the closure of the ring is effected, and may pass into the connective tissue of the cord itself, before that structure has separated. We have seen such a case in which the integuments covering the sac sloughed. Rather later, after the separation of the cord, the hernial sac may be protruded in consequence of the umbilical aperture remaining imperfectly closed when it is covered only by the integuments. In youth, a rupture may be developed by escaping through a partially closed ring, which, by continued pressure, it dilates, unless precautions be taken to prevent it. And, in adult life, the fibres of the linea alba become separated by stretching or yielding to the pressure from within, and the rupture escapes at the site of the once closed ring, or in its immediate vicinity. The coverings of the hernial sac are generally very thin, and often inseparably united together. They consist of the integuments; some fat, which, however, is not often in proportion to the thickness of the layer over the other regions of the abdomen; and the delicate internal abdominal fascia. The body of the sac is usually very delicate, but it is rather stronger near and at its orifice, around which part the tissues outside of it form a very firm, resisting, unyielding band. The mouth of the sac is often large in proportion to the bulk of the protrusion. The relation which it bears to the tumor when the protrusion is large should be carefully studied. As the bulk of the hernia increases, it does not spread equally around the ventral aperture upon the anterior surface of the abdominal walls, but it descends towards the symphysis pubis more than in any other direction. In some cases it happens that the transverse diameter of the tumor is greater than the vertical; and occasionally its configuration is so pyriform that the tumor seems to be suspended by a peduncle or stalk. At other times its base is nearly as large as its body; and, again, we may see an almost sessile tumor, which, when elevated, is attached by a small stalk, thus resembling a mushroom in shape.

Various organs of the abdomen are found in the sac of an umbilical hernia; very frequently the omentum, the stomach,[1] portions of the small intestines and of the large. When the disease has been neglected, we have seen nearly the whole of the intestinal canal in the sac, enveloped by omentum. The last-mentioned organ sometimes becomes firmly united to the sac; and when bands or septa are thus produced within it, the intestines may become entangled by them. The omentum likewise becomes hard and contracted, forming masses within the sac which sometimes give rise to difficulty in diagnosis.

This rupture begins by forming a small soft projecting ovoid tumor at the navel. Gentle pressure with the finger pushes something into the abdomen, and a small hole is then felt, with very sharp, rigid edges. Directly the finger is removed, the skin either remains relaxed or flabby in the fossa of the navel, or it is slowly projected forwards, and reappears in the same bold relief. If the progress of the disease be not arrested, the protruding viscus descends lower and lower, so that the broadest part of the tumor lies below the mouth of the sac. A curious example of congenital umbilical hernia, coupled with malformation, was shown by Dr. Gibb at the Pathological Society, and in the same volume of the Transactions there is a description of a case of triple umbilical hernia which contained portions of the stomach, duodenum, jejunum, ileum, omentum, and ductus communis choledochus.[2]

Treatment when reducible.—Should there be any disposition to a protrusion at birth, or soon after, the simple application of a bandage is not merely palliative, but materially tends to the cure of the case. In infancy, after the separation of the cord, the protrusion may be prevented by fixing a piece of cork over the umbilical ring. It should be circular, about one inch in diameter, slightly convex on both surfaces, and covered with soft leather. With adhesive plaster to retain it in its proper place, and a bandage encircling the abdomen but not violently compressing it, this plan is sure to be attended with advantage. In the majority of cases the complaint will be cured. When the protrusion occurs in an adult, a suitable truss or bandage must be employed, with a view to prevent the dilatation of the sac and the increase of the tumor. If a large irreducible hernia has to be treated, a suitable appliance is required.

The radical cure of this hernia has

[1] A very interesting case is related by Mr. Moore, in the Med.-Chir. Trans., vol. xlvi., p. 181.

[2] Trans. of the Pathological Society of London, vol. vii., pp. 216, 220.

been successfully effected by an operation performed by Mr. Barwell, on three patients, at the respective ages of six months, fifteen months, and eight years.[1] It is, however, open to further inquiry, how far any cutting operation is justifiable in infancy, as so large a proportion of cases are curable by bandages or trusses. Mr. H. Lee states that he has cured cases by inserting needles through the sac, after carefully reducing its contents, and keeping the surfaces in close contact by twisting a ligature over them. Mr. Wood makes use of rectangular pins and the wire suture. [Archambault (London Med. Record, Nov. 15, 1876, from Paris Médical, Oct. 12) claims to have obtained radical cures by means of the application of a plug or hemisphere of white wax or of gutta-percha. After a few hours these adhere, he says, so as to require no bandage.]

Mr. C. Heath, having been called on to operate in a case of strangulated umbilical entero-epiplocele, after having returned the bowel, dissected the sac from its attachments; and having passed a ligature through its base and the omentum, cut them off. The patient recovered; and when the report was given to the Pathological Society there was not then any hernial protrusion.[2] But we are at a loss to understand how the opening in the linea alba was closed by these means; and, therefore, until it can be shown that this has been accomplished, we should not recommend the adoption of this measure.

Cases of umbilical hernia offer remarkably well-marked examples of that condition termed obstruction from accumulation of stercoraceous matters, and patients are constantly subject to severe constitutional disturbance arising from this cause alone, and not from positive strangulation of the bowel. We should not, therefore, be in a great hurry to operate in these cases; for after a free administration of aperient enemata, the contents of the sac become unloaded, and evacuations from the alimentary canal are obtained.

The operation.—An incision should be made in the mesian line of the body, commencing about two or three inches above the upper border of the mouth of the sac, and continued downwards upon the sac as far as may be requisite. [Demarquay proposes to make the incision obliquely on the left side of the tumor, thus avoiding both the umbilical vein and the linea alba.] The smaller the opening by which the surgeon can remove the impediment to the reduction of the hernia, or liberate the bowel from constriction, the better; and when it can be accomplished without opening the peritoneal sac, it is desirable to do so. Great caution is necessary whilst cutting the different coverings of the sac; and should it be necessary to cut the tissues forming its orifice, the incision should extend upwards in the same line as the first.

Hernia in the loins.—Lumbar hernia has been described by several surgeons. These protrusions arise after contusions of this region, or perhaps after lacerations of the abdominal muscles in the part, as well as from relaxation of the tissues. In the third Bulletin des Travaux de la Société de Médecine de Marseille, Dr. Chaplain[1] relates the case of a man, aged sixty, who, after being squeezed between a wall and a carriage, found in his loin a tumor between the crest of the ilium and the last rib. It appeared at first like a chronic abscess, but the presence of intestine was easily ascertained. Mr. Kingdon has seen a case of this kind. The bowel protruded just above the crest of the ilium at its highest point, about three inches from the spine, just where the quadratus lumborum and abdominal muscles meet. The man was fifty-four years old, tall and thin. He suffered with hæmoptysis and emphysema of the lungs.

Herniæ in the Hypogastric Region.

Inguinal hernia is the most common kind. The statistics of the City of London Truss Society prove this; for rather more than two-thirds of the total number of applicants of both sexes for trusses to support every description of hernia, were afflicted with inguinal ruptures of one kind or the other.[2]

[1] The Lancet, 1861, vol. ii., p. 419, etc.

[2] Transactions of the Pathological Society, vol. x., p. 131.

[1] L'Union médicale, 1862, vol. i., p. 157.

[2] Table B.—*Showing the proportions between inguinal and femoral hernia in both sexes at different ages.* (Constructed from Kingdon's tables, 1860–61.)

Ages.	Inguinal.		Femoral.	
	Male.	Female.	Male.	Female.
1 to 20	2435	249	23	38
20 " 40	2954	322	139	432
40 and upwards	2154	128	144	278
	7543	699	306	748

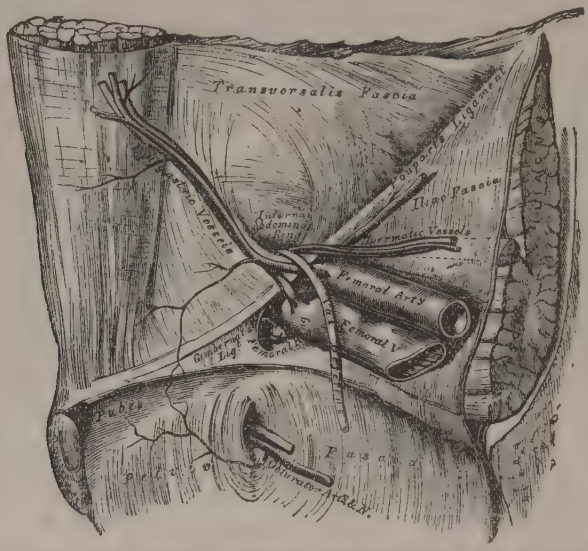
This table shows—

1. That inguinal hernia is most common.
2. That in females femoral and inguinal hernia occur in about equal proportions.
3. That femoral hernia in the male is the least common of these kinds.

Of inguinal hernia the following varieties are described: the oblique or external, and the direct or internal. The terms external and internal have reference to the course taken by the internal epigastric artery in relation to the orifice of the hernial sac. In the oblique kind, the mouth of the sac is situated to the outer or external side of this artery; in the direct, this important part of the sac is placed to the inner side of the same vessel.

[It may be well here to define clearly, on anatomical grounds, the various forms of hypogastric herniæ; and the reader will have no difficulty in understanding them, after a careful study of fig. 419. This represents the inner face of the abdominal and pelvic wall, the peritoneum having been stripped off.

Fig. 419.



Hernia. The relations of the femoral and internal abdominal rings, seen from within the abdomen. Right side.

All *inguinal* herniæ escape above Poupart's ligament, and almost all of them go through the internal abdominal ring, following the course of the vas deferens and spermatic vessels along the inguinal canal. *Femoral* herniæ pass out below Poupart's ligament, through the femoral ring. *Obturator* herniæ escape by way of the obturator foramen.]

There are also varieties of the oblique kind named according to the situation of the protrusion; thus the tumor is called a "bubonocele," when the hernia has passed the internal inguinal ring, but has not protruded at the external, when in fact, it is retained in any part of the inguinal canal. It is called "scrotal hernia or oscheocele," when it has passed through the external abdominal ring, and is therefore in the scrotum.

We propose the following anatomical classification of the varieties of oblique inguinal hernia.

1. Into the vaginal process of the peritoneum (the congenital hernia of Haller and subsequent writers).

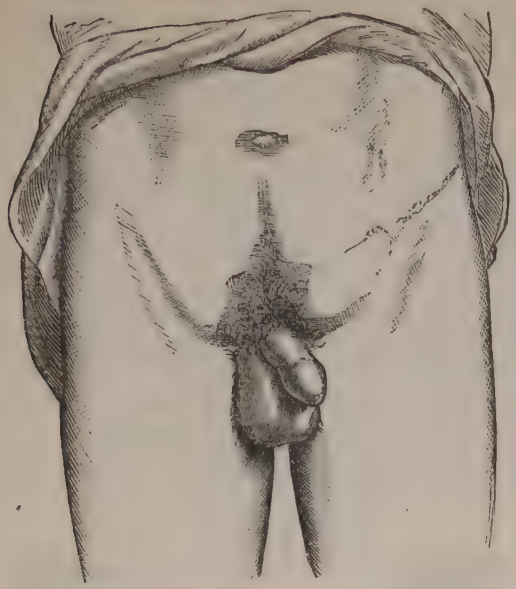
2. Into the funicular portion of the vaginal process of the peritoneum.

3. Scrotal, the sac being thrust into the tissues of the scrotum.

Of inguinal hernia in the male.—This species escapes from the abdomen, *above* Poupart's ligament, through the internal and external inguinal apertures or abdominal rings. There are two varieties, the *oblique* and the *direct*.

Oblique inguinal hernia, having passed through the internal inguinal ring, lies in the inguinal canal. Pursuing the oblique direction of this canal, it emerges at the external inguinal ring, and enters the scrotum, into which it descends. [In rare cases, when the testis is undescended, the knuckle of gut curls outwards along the fold of the groin.] The mouth of the hernial sac is situated to the outer side of the internal epigastric artery, whilst its neck and body are usually in front of the structures composing the spermatic cord. But in rare cases these organs are divided; sometimes the blood-vessels pass over the tumor, the vas deferens behind it, and *vice versâ;* or they are attached to the sides of the tumor. The relative positions of the hernial tu-

Fig. 420.



The annexed woodcut represents double inguinal hernia. On the man's right side the protrusion has passed through the inguinal canal, and is just entering the scrotum. On the left side it is called "bubonocele." The outline of Poupart's ligament, below the swelling produced by the protrusion, is distinct.

mor and testicle differ. The variable site of this organ depends upon congenital defect, and hence in some cases the testis cannot be distinguished from the tumor produced by the hernia. However, in the majority of cases the testicle is situated at the posterior and inferior region of the scrotum; more rarely, it may be detected at the front of the fundus of the tumor. An endeavor should always be made to ascertain the site of this organ, in every case of inguinal hernia, and under all circumstances.

[Prof. Agnew, referring to the alleged greater frequency of inguinal hernia on the right than on the left side, ascribes it to the mode of attachment of the mesentery, which allows the intestine greater freedom in that direction.—Phila. Med. Times, July 17, 1880.]

The coverings of the sac of an oblique inguinal hernia are formed by the tissues of the region in which it lies. To expose the sac of a bubonocele, it is necessary to divide the integuments of the groin, the aponeurosis of the external abdominal oblique muscle, and the internal spermatic fascia. Some of the fibres of the free edges of the internal oblique and transversalis muscles are observable along its upper border, and some fibres of the cremaster muscle skirt its lower edge. To reach the sac of a scrotal hernia, we must divide the integuments of the scrotum, including the dartos, the fibres of the cremaster muscle, often strongly developed, and the internal spermatic fascia. This last-named fascia is the delicate membranous extension of the internal abdominal fascia along the spermatic cord.

The mode of development of the sac of an oblique inguinal hernia differs essentially in respect of the age of the individual in whom it takes place. Thus, in infancy, youth, and early manhood, the disease is usually dependent for its existence upon a congenital imperfection. To this circumstance is due the persistence of a serous canal, or sheath, in direct communication with the peritoneal cavity, through the mouth of which a portion of omentum or bowel may enter, and thus form a hernia at any period of life. On the contrary, in adult life the hernial sac is a secondary structure, a distinctly new formation. Its development is slow; its progressive stages may be traced; and, although a prolongation of the peritoneum, its existence is due to a morbid action, which allows displacement or stretching of this serous membrane.

Hernia into the vaginal process of the peritoneum.—The development of these two very different kinds of sacs has been already described (see p. 671), in considering the causes of hernia; and at the same place the reader will find the reasons which induce the author to prefer the designations of "hernial into the vaginal process" and "into the funicular portion," to those of "congenital" and

"infantile," formerly in use. There also the natural varieties found in the condition of this process are described.

Under abnormal conditions, the following states of the sheath are found :—

1. The whole length of the canal remains open.

2. The entire canal may remain open, and an annular constriction of its walls take place between the external abdominal ring and testis.

3. The tunica vaginalis propria testis is perfected, becomes now a closed sac, but the canal continues to exist as far as the testis.

4. The abdominal orifice is completely closed, but the canal below this exists.

The diagrams are intended to illustrate the congenital conditions of the vaginal process of the peritoneum. The serous canal is represented cut open vertically and viewed from the front.

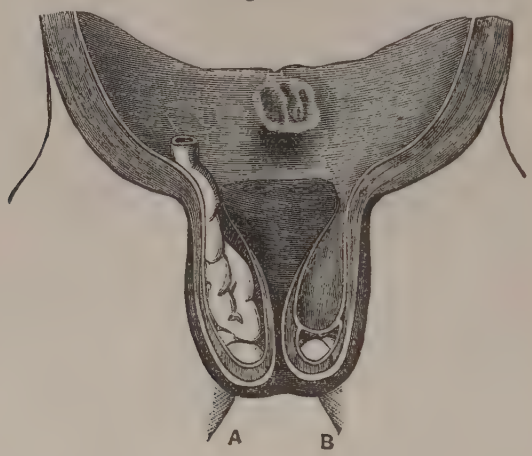
Fig. 421, A. The tubular process of the peritoneum is open from the general peritoneal cavity to the fundus of the scrotum, at which part the testis is situated. This gland, however, may be fixed at different sites.

Drawings representing this imperfection may be found in the following works: Camper, Icones Herniarum, tab. x., fig. 3 ; Hunter (John), in Medical Comm., pt. I., chap. ix., and in Palmer's edit. of the works of J. Hunter, plates xxv., xxvi. For numerous references to books on this subject, refer to A Treatise on Ruptures, by W. Lawrence, F.R.S., 5th edition, 1838, p. 564.

The variety of hernia developed in consequence of this imperfection is the hernia congenita of Haller and subsequent authors.

Fig. 422, A. In this figure the vaginal process of the peritoneum is open, as in the last imperfection ; but a contraction has taken place at the point above the testis.

Fig. 421.



This imperfection is demonstrated by a preparation in the Museum at Guy's Hospital, No. 2368 ; and by a drawing from a case reported by Sir Charles Bell, in the London Medical Gazette, 1828, vol. i., p. 485.

Examples of hernia into a vaginal process of this kind are noticed by Scarpa ; see Wishart's translation, Memoir, ii., § 10. A drawing of a similar case may be seen in the work by Sir Astley Cooper on Abdominal Hernia, the 2d edition by Mr. Key, pl. II., fig. 2. Another is related by Mr. Lawrence in his work on Ruptures, as before, p. 574 ; and I have myself operated upon cases of this kind in young men. A large hernial sac with this remarkable condition may be examined in the Museum of the Royal College of Surgeons of England, No. 1343.

Fig. 421, B. This diagram shows the division of the vaginal process of the peritoneum, into the inferior testicular vaginal process ; and the superior funicular vaginal process, at the ventral end of which a communication with the abdomen remains, as on the other side.

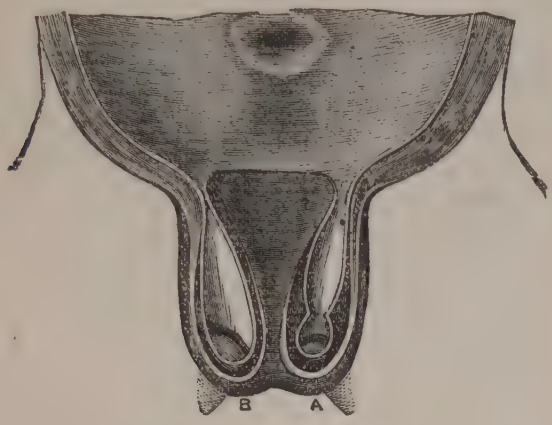
This imperfection is delineated by Camper. In the work Icones Herniarum, folio, 1801, plate x., he contrasts it with that one represented in fig. 421, A. The drawing was made from the dissection of an infant, in 1759. Seiler also gives a figure to illustrate a rather more contracted state of this part of the vaginal process, in a work entitled Obs. de Testiculorum ex abdomine in scrotum descensu, etc. More recently, M. Malgaigne has described the frequency of hernia in association with this imperfection, Leçons clin.

sur les Hernies, Paris, 1841; and in L'Union médicale, 1854.

Examples of hernia into the funicular portion of the vaginal process of the peritoneum occur very commonly in children, and a preparation of a hernial sac, originating with this defect, is preserved in the Museum of the Royal College of Surgeons, No. 1328.

Fig. 422, B. In this diagram the vaginal process is represented as a tube passing down in front of the spermatic cord and testis. The ventral orifice has been closed above.

Fig. 422.



This is the condition of the vaginal process of the peritoneum described by Mr. Hey, in which he "found that the tunica vaginalis was continued up to the abdominal ring."—Practical Obs. in Surgery, 3d edit., 8vo., 1814, p. 227.

I suspect that it is this imperfection of which preparations exist in museums, described as "a congenital hernial sac with the mouth obliterated," when unaccompanied with a history that the man from whom it was removed had ever been ruptured.

Associated with congenital persistence of the vaginal process of the peritoneum, the testicle of the same side as that on which the defect occurs frequently occupies an abnormal situation.

When in its normal site at the lower part of the scrotum, it cannot always be distinguished from the hernial protrusion which occupies the same serous sac as this organ and overlies it. But although this region should contain a hernial tumor, the testis may not have reached the scrotum at all.

The situations in which it is then found are as follows:—

1. Within the abdomen; the vaginal process extending into the inguinal canal, but not reaching further than just through the external abdominal ring, or into the upper part of the scrotum.

2. Fixed in the inguinal canal out of the reach of manipulation; whilst the serous canal, passing into the scrotum, froms a sac for the reception of a hernia.

3. Immediately outside the external abdominal ring, at the upper part of the scrotum; in which state, when a hernia descends, it passes in front of this organ into the scrotum, even as low as its fundus.

A defective development of one or even both sides of the scrotum is associated with the cases of deformity above described which may lead the surgeon to discover an abnormal position of the testis; a fact of great importance in the treatment of these cases of hernia.

Tabular view of the abnormal conditions of the vaginal process of the peritoneum, deviations from the normal situation of the testis, and the relative position of the hernia.

Hernia into the vaginal process of the peritoneum:—

1. The vaginal process continuing open and common to the cord and testis. (Fig. 421, A.)

The testis may be situated—

a, in its normal site at the fundus of the scrotum;

b, just outside the external abdominal ring, or between its pillars;

c, within the inguinal canal;

d, within the abdomen.

N.B. In *a*, *b*, *c*, the hernia is generally in contact with the testis; in *d* it is not.

2. The vaginal coverings of the cord and testis communicating by an aperture.

The testis in the scrotum.

N.B. The hernia may or may not pass through this aperture, and is therefore sometimes but not always in contact with the testis. (Fig. 422, A.)

3. The vaginal covering of the cord only being open. (Fig. 421, B.)
   The testis in the scrotum.
   N.B. The hernia is never in contact with the testis.

APPENDIX.—*Additional sacs, or prolongations and extensions of the vaginal process within the abdominal walls.*

Concurrent with these instances of malplaced testis are some of those complicated cases of hernia which arise from varieties in the configuration and anatomical disposition of the hernial sac. In a majority of the cases in which the hernial sac follows any very unusual direction, the hernia is found to occupy the same sheath as the testis, or a portion of that sheath—a sufficient proof of the precise nature of the hernia and of the cause of its development, if any be required. Several cases are recorded in which a sort of second sac or offset from the vaginal process of the peritoneum extended between the structures composing the abdominal walls. Hence the terms "intraparietal," "ascending, or intermuscular," and "interstitial," have been applied to this variety of hernial sac. Belonging also to this category are the cases termed "hernie en bissac" by French writers. These cases form two classes :—

1st. Those in which the sac extends into the anterior abdominal walls.

2d. Those in which it extends into the inferior walls.

In the first class, the sac extends upwards from the inguinal canal in front of the internal abdominal fascia, and behind the aponeurosis of the external abdominal oblique muscle. It may take a course directly upwards ; outwards, towards the crest of the ilium ; or inwards, towards the rectus muscle and umbilicus.

If the sac has passed through the external abdominal ring and cannot enter the scrotum, it may ascend in *front* of the aponeurosis of the external abdominal oblique muscle, lying between it and the integuments ; and when the hernia protrudes, it forms a tumor in the groin above and parallel with Poupart's ligament. An example of this rare variety is quoted by Scarpa,[1] and another case has been recorded by Dr. Fano.[2]

In the second class, the sac extends into the iliac fossa and rests upon the iliacus muscle, between the internal abdominal fascia and peritoneum ; or directing itself inwards, it passes behind the horizontal ramus of the pubes, and reaches the side and front of the urinary bladder.[1]

Hernia into the funicular portion of the vaginal process of the peritoneum.—When the surgeons of the last century discovered that a hernia could pass into the vaginal process of the peritoneum, and there be in contact with the testicle, they appear to have been content with this fact, and, without further research, to have assumed this variety to be the only form of hernia dependent for its origin upon non-closure of the ventral orifice of this canal, or defective obliteration of the upper part of the vaginal process of the peritoneum. Thus many writers acknowledge the fact that an infant may be the subject of a scrotal hernia, and, after detailing such a case, they add, "but not congenital ;" implying by that expression simply the anatomical fact that the hernia is in a distinct sac, and thereby separated from the testis, in the same manner as it occurs in the adult. The term suggested in this essay precludes an erroneous view of those varieties of hernia which originate in congenital defect of the coverings of the testis and spermatic cord, and renders the disease in the infant and in youth much more easy of comprehension.

The reader should recall to mind the previous statements relating to the descent of the testicle, and the development of the tunica vaginalis propria testis out of the inferior termination of the vaginal process of the peritoneum. For surely there cannot be a tunica vaginalis propria testis developed so long as a canal exists along which a hernia may descend and touch the testis. Herein consists the deficiency; in this anatomical fact lies the defect. But when the testis is enveloped by the two layers of the serous membrane, the visceral and parietal, whereby the cavity of the tunica vaginalis testis is formed, in its own proper vaginal sheath, and is entirely shut off from every protruding viscus, there may yet remain the upper portion of the vaginal process of the peritoneum communicating with the abdomen at the internal abdominal ring. Into this canal, termed the tunica vaginalis propria funiculi, or the funicular portion of the vaginal process of the peritoneum, a hernia may protrude, and the canal thus become converted into a hernial sac ; quite as much "congenital,"

[1] Treatise on Hernia, translated by Wishart, 1814, 8vo., p. 171.

[2] L'Union médicale, December, 1861.

[1] Cases by Dr. Parise, in Mém. de la Soc. de Chir. de Paris, 1851 ; Mém. sur deux variétés nouvelles des Hernies.

too, as the variety ordinarily characterized by that term, for it is dependent upon a congenital defect, viz., the non-closure of the abdominal orifice of the canal, and its continuation in front of the spermatic cord as far as the testis and its vaginal sheath. This variety is now distinguished as hernia into the funicular portion of the vaginal process of the peritoneum.

In the new-born infant, or at a later period, some weeks or some months after birth, it is not at all uncommon to see males with a hernial protrusion occupying the inguinal canal and scrotum, but entirely separated from the testis, which is normally situated, at the fundus of the scrotum.

M. Malgaigne was, I believe, the first surgeon to notice this variety of hernia, and to point out its origin, anatomical relations, and distinctive features. It is exceedingly common. Carefully instituted examinations lead us to conclude that it is nearly as frequently met with as the ordinary variety last described; but, from the fact of its having been confused with the scrotal hernia of the adult, very little attention has been bestowed upon it. The diminutive size of the testis has also led to its relative situation, as regards the hernia, being wholly overlooked and neglected; for cases which we have ourselves examined have generally been regarded as of the ordinary kind, termed "congenital," and not worthy of further consideration. In the earlier periods of life, the distinction is not, perhaps, of primary importance; but the recognition of this variety in youth and adult life becomes a necessity of great moment in some instances, not only in reference to correct diagnosis, but also with respect to the judicious treatment of the case.

In these cases, the hernia being enveloped by a peritoneal sac, the pathologist must admit one of two explanations of its development: either that the parietal peritoneum of the abdomen was suddenly pushed downwards before the hernia to form its sac; or that a serous canal existed continuous with the peritoneal cavity, which became converted into the hernial sac. The last explanation, being strictly in accordance with anatomical facts, appears to me to be the one which the morbid anatomist will adopt.

The congenital patency of the funicular portion only of the vaginal process of the peritoneum is capable of proof by anatomical examination, and there is no more reason to question its remaining so during the later periods of life, than to dispute the fact of the occasional unobliterated state of the entire length of the vaginal process of the fundus of the scrotum in adult life. We are able to adduce abundant facts to prove the development of hernia in such cases, if space permitted.

In advancing adult life the orifice of the hernial sac still maintains its original relations to the internal abdominal ring, and especially its depth. Under these circumstances, a hernia having existed many years, the abdominal rings are not approximated, but remain widely separated. A man, forty-five years old, was operated upon by myself on account of strangulated oblique inguino-scrotal hernia, with which he had been afflicted since boyhood. This was the first time he had found any difficulty in returning the protrusion. The orifice and neck of the sac were deeply seated; that is, the index finger was passed along the inguinal canal to reach the abdominal orifice of the sac. It did not require division, but was sufficiently large to allow of the reduction of the hernia after the sac had been opened and a large quantity of serum had escaped. His case terminated successfully. The testis was at the fundus of the scrotum, and separated from the contents of the hernial sac.

The next question relates to the frequency of these varieties of hernia into the vaginal process of the peritoneum.

After making inquiry of patients afflicted with inguino-scrotal hernia for many years, we were much surprised to find that so many of them stated that the protrusion occurred suddenly, and was first observed when the dimensions of the scrotum were increased by the presence of the hernia. Another circumstance also attracted attention. Robust, healthy, and well-developed men, of middle age, asserted that the rupture first descended when they were about twenty years old—a circumstance nowhere specially alluded to; but it appears to be a very common occurrence. When discussing this matter with friends, and stating this fact, they have suggested that workingmen might not be very accurate in their statements, and that, being habitually thoughtless of their persons, no dependence could be placed upon their assertions. This objection has had its due consideration and weight in our inquiries, and we have, therefore, only referred to recent cases, or accepted the accounts afforded by those patients who seem to possess a fair average intelligence and might be presumed to give reliable information concerning the subject of inquiry. During the two years 1859 and 1860, forty-four patients, suffering more or less from inguinal hernia, were admitted into the wards of Guy's Hospital. Among them were twenty-six cases of hernia into the vaginal process of the peritoneum; and of these, twelve had the testis and hernia in

contact (the hernia congenita of Haller), whilst in the remaining fourteen the hernia occupied the funicular portion of the canal, and was separate from the testis. In several patients the hernia was developed suddenly, and reached the scrotum at once, the first time it was observed, even in adult life, the men being robust and well-developed. The respective ages of the patients, at the time they came under examination, varied between fourteen months and forty-seven years.

Pott wrote, nearly a hundred years since: "Ruptures attended with that particular circumstance which brings them under the description mentioned in the title, are said to be very rare; but from what I have observed, both in the living and in the dead, I am inclined to believe that they happen much oftener to adults than they are suspected to do.[1]

To demonstrate, perhaps even more satisfactorily, that a large proportion of the cases of inguinal hernia is developed at a very early period of life, we may refer to the Reports of the City of London Truss Society, so industriously drawn up by Mr. Kingdon.

The total number of males applying to the Society during the years 1860 and 1861, whose ages were ascertained at the time the hernia was first observed, amounted to 7543; of these 3963, or 383 more than half, had reached only thirty years of age. Thus it appears certain that inguinal hernia is developed very frequently before thirty years of age.

This statement, which may be accepted as correct, is fully supported by reference to the table I have arranged from the Report of the City of London Truss Society (see Table, p. 668). By this it appears that inguinal hernia occurs very frequently during the first twelve months after birth. This happens in consequence of the congenital persistence of the canal of the vaginal process of the peritoneum. Its frequency then diminishes to puberty, after which period the cases rapidly increase to the completion of thirty years of age.

Taking periods of ten years, or decades, the frequency of inguinal hernia at different ages is well seen (see Table, p. 711). It is remarkable that the first decade contains the largest number of cases, and next the third, or that between twenty and thirty years of age. From this period of life the cases decrease in a rapid ratio.

Hour-glass-shaped contraction of the sac of oblique inguinal hernia.—An uncommon peculiarity in the conformation of the sac itself of an oblique inguinal hernia occurs in consequence of a narrowing of its walls at a point corresponding with the site of the external abdominal ring, or a little below that point in the scrotum, between the testis and that aperture. When a hernia fills the sac, it may become strangulated by this constriction. The outline of the hernial tumor, as well as that of the sac, exactly resembles the shape of the ordinary hour-glass; hence the name given to it. It is always associated with a congenitally open state of the vaginal process of the peritoneum. The result of the imperfect closure of this sheath at that part where union of its walls normally takes place, is to give rise to the formation of a ring or circular constriction within this process of the peritoneum, at the point where the tunica vaginalis propria testis and tunica vaginalis propria funiculi meet together. Instead of the upper division of this canal being closed, and the two divisions, by this means, rendered distinct from each other, they communicate freely. The result is, that a hernia passes through the abdominal orifice of the funicular portion of the canal, traverses it, and then passes through the constriction into the cavity of the tunica vaginalis propria testis, which gland it touches. Instances of this constricted condition of the sac of an oblique inguinal hernia are related by Pott,[1] Wrisberg, Le Cat, Scarpa,[2] Pelletan, Sir A. Cooper, and Mr. Lawrence.

Case.—A laborer, twenty-nine years old, was brought into Guy's Hospital in September, 1858, in a state of great prostration, and having a rupture in the left side of the scrotum. There had never been any tumor noticed until seventy-eight hours before admission. All observers were struck with the small size of the neck of the tumor, its pear-shaped form, thus closely resembling the outline of a hydrocele, and the seeming absence of the left testis. The external abdominal ring was distinctly recognizable, and I could pass my fingers through it, but I could not make out distinctly the spermatic cord. On palpation a very audible gurgling sound was produced in that division of the swelling between the internal ring and the upper part of the scrotum, the integuments of which were red, tense, and shining. The whole tumor was divisible into a superior division and an inferior. This last, which was the largest, remained unaltered by manipulation, was firm, and resisted pressure, although slightly elastic, and was very painful when compressed. The upper division was soft, and the swelling entirely disappeared when

[1] An account of a particular kind of Rupture, etc., viz., that in which the Intestine or Omentum is found in the same cavity and in contact with the Testicle, by P. Pott, London, 1765, 2d edit., p. 5.

[1] Chir. Works, edit. 8vo., 1808, vol. ii., pp. 118, 184, case xiv.

[2] A Treatise on Hernia; translated by Wishart, 8vo., 1814, p. 138, pl. v., fig. 2.

slight pressure was applied; but it was reproduced by the contraction of the abdominal muscles, or by pressure on the abdomen over the internal ring. All the symptoms of strangulated intestine being strongly marked, and considering that the liberation of the hernia was imperative, I administered chloroform; and finding, when the man was fully under its influence, that I was still unable to reduce the protrusion, I determined to operate at once. An incision of the integuments, four inches long, was made, the direction of which was parallel with the long axis of the tumor, and the centre corresponded with the site of the external abdominal ring. This aperture, although seen, was not sharply defined. I could now pass my finger upwards on the outside of the hernial sac to the internal ring, and trace its boundary. A very distinct constriction was now seen in the body of the tumor, producing the form of an ordinary hour-glass. This constriction corresponded with the ramus of the pubes, over which it crossed. I opened the superior division of the hernial sac above this constriction, and exposed healthy intestine only. I next endeavored to extricate the bowel from the inferior division of the sac; but I was unable to release it. A grooved director was carefully introduced into the inferior sac, and much blood-tinged serum escaped along the groove. Still, even when all the serum had run out, and traction was made on the bowel from above, it was inextricable! What chance then was there of reducing the bowel by the taxis? The constriction of the sac having been divided, the strangulated bowel was easily returned into the abdominal cavity without any enlargement of its abdominal orifice being required. The left testis was visible at the fundus of the sac—sufficient evidence that the hernia had descended into the vaginal process of the peritoneum. This man recovered.

Other cases of this kind have occurred in my practice. They are not, I suspect, quite so uncommon as at first sight we might be led to assume. Out of forty cases of oblique inguinal hernia, which Mr. Kingdon selected for me, in order to illustrate quite a different subject, I find that he observed the characteristic hour-glass constriction of the scrotal tumor in four men in whom the hernia was developed at the respective ages of seventeen, twenty-nine, and thirty years, and one in boyhood.

But what explanation can be given of the constriction of the bowel by the sac at such an unusual part? Let us seek for it by an examination of preparations and a reference to the physiological changes taking place in the vaginal process of the peritoneum before, or soon after, birth. Before doing this, let us distinctly isolate and exclude from the class of cases about which we are writing all those in which the impediment to the reduction of the hernia, or the cause of constriction of the bowel, depends upon the development of adventitious bands crossing the cavity of the sac without any definite or specific arrangement. Hernial sacs, showing such peculiarities as last mentioned, are preserved in the London museums; but they are quite foreign to our immediate purpose, and belong to a perfectly distinct category as regards their development and relations to the sac and its contents.

In the cases we are now describing the hernial protrusion and testis are in contact, otherwise the case would not belong to this class.

In the Museum of the Royal College of Surgeons there is a Hunterian preparation, No. 1343, thus described in the catalogue: "The sac of a large congenital hernia. The exterior of the sac is uneven and sacculated, through the unequal yielding of different parts of its walls; the testicle is situated at the lowest part." This account is not sufficiently explicit or descriptive of the structure of the hernial sac and its relations to the testis. A careful examination of the interior of the sac shows a large superior division and a small inferior. In the latter the testis may be recognized; but between the divisions an imperfect septum, or perforated diaphragm, existed before the vertical section of the entire sac was made, and by means of this foramen a communication was established between them. The sharp, well-defined, free edges of this septum are seen stretching from the sac-wall to the testis, as well as its strong attachment to the sac itself. Now assume the cut edges of this sac to be joined together, and the superior and inferior sacculi would be complete, although any foreign body might be passed from the one into the other. A hernia, for example, filling the upper sacculus, might pass from it through the aperture in the diaphragm into the lower, and then become constricted by the margins of this annular contraction.

But a preparation in the Museum at Guy's Hospital, No. 2368, at once affords a satisfactory clue to the solution of these somewhat remarkable cases. It is the vaginal process of the peritoneum taken from a child. It shows a portion of the parietal peritoneum of the abdomen with the whole process extending downwards from it. This process has been opened along the whole extent of its anterior surface. At the superior extremity the canal communicated with the abdomen, and at the inferior extremity the testis may be seen; and between these two points, about midway, the cavity is contracted. When this tube was uncut, there must have been an opening or narrow passage near its centre, through which a protrusion, coming by the abdominal orifice, and traversing the funicular portion of the vaginal process, must have passed to reach the testis. A constriction resembling this formed the impediment to the reduction of the hernia in the cases above described.

Sir Charles Bell describes a hernial sac of this kind which came under his observation in connection with an obscure case of hernia, which he has recorded in the London Medical Gazette of 1828.[1] "There was another re-

[1] Vol. i., p. 484; also a woodcut.

markable circumstance observed, which related to the sac lodged in the scrotum. At the lowest part there was a hole of communication between that sac and the cavity which is between the coats of the testicle. This orifice was so large that the finger could be passed through it; and its margins were so dense as to resist dilatation." In the explanation of the woodcut, he writes: "A bougie has been passed from the hernial sac into the cavity formed by the tunics of the testicle, through an opening which forms a communication between them."

A careful examination of the second figure of the 2d plate of Key's edition of Sir Astley Cooper's work on Hernia will satisfy any one that it delineates a case of the kind we are describing. It was a "congenital hernia firmly constricted by an annular contraction of the sac itself," although described as "a band of membrane adhering to the sides of the tunica vaginalis, *through an aperture in which* the intestine has protruded and become strangulated." The hernia is seen both above and below this aperture; the portion below "discolored by the effects of strangulation" produced by its margins; the portion above, "below the internal ring and above the strangulating band, free from pressure and retaining its natural appearance." Now in this description we have but a repetition of the appearances I observed in the case under my own treatment, related at p. 718. In chap. xvii. on Congenital Hernia, Sir Astley Cooper states that in this variety "the stricture is much oftener found to be *within the sac*, than in the ordinary kinds of hernia;" and he relates a case, upon the authority of Mr. Hodgson, of Lewes, in which the intestine "was found strangulated within an aperture of the tunica vaginalis. The intestine appeared to have suffered more from this stricture than from the ring."

Lastly, Mr. Lawrence,[1] when describing cases of this kind, records one in which, "about half-way between the testis and groin, the hernial sac was so contracted that a probe only would pass into the stricture." In this case, too, the abdominal orifice of the sac "would not admit the smallest portion of the tip of the finger," and it also formed an impediment to the reduction of the hernia; in this respect differing from my case.

By these quotations, to which numerous instances might be added, especially those recorded by Mr. Pott, with dissections, case 14,[2] it is capable of demonstration that this class of cases must be confined to those forms of inguinal hernia dependent upon congenital defect or persistence of the vaginal process of the peritoneum throughout life.

But a glance at a plate in Camper's work[3] will more easily explain the nature of these cases. Figure 2 shows the cavity of the right vaginal process of the peritoneum opened vertically from the abdomen to its inferior termination; at which point is seen the testis. Figure 3 shows the left side, in which, just above the testis, the entire canal is divided into two portions by the internal surfaces of the serous membrane united together. Should it, however, happen that this septum is not complete, a mere contraction takes place, and a ring is thus formed, keeping up a communication between the persistent funicular portion of the vaginal process, which is above, and the cavity of the imperfect tunica vaginalis testis below. By the constant pressure around a hernia, the tissues composing this annular contraction of the hernial sac become more and more dense, until it forms a firm, fibrous, callous ring at the situation where the tunica vaginalis ordinarily terminates, just above the testis; its variable distance from that gland depending, in different cases, upon the larger or smaller size of the protrusion, and the consequent distension of the tunica vaginalis testis.

The differential diagnosis between these cases of hernia into the vaginal process of the peritoneum, and the ordinary form of inguino-scrotal hernia, is formed by the manner of their development, the age at which they first appear, and their configuration. Whilst the common form is developed slowly, these appear suddenly, and often pass at once into the scrotum without resting in the inguinal canal. They are noticed in the earliest infancy, throughout childhood, and during early adult life. Their form or outline is highly characteristic. The tumor projects in a remarkable manner from the external outlet of the inguinal canal; directly the rupture escapes from the embrace of the external abdominal ring, the form is more globular and rounded in comparison with the pyriform outline of the hernia of slow formation in adult life. The testis can or cannot be felt; when it is easily detected, it is evident that the gland and rupture are in separate sacs, and *vice versâ*.

[Dr. Gurdon Buck reported a case (Am. Journ. of the Med. Sciences, Jan. 1871) in which the tunica vaginalis was merely dilated into a tubular canal of uniform calibre, and the diagnosis was thereby rendered very difficult.]

In the hour-glass-shaped variety the configuration alone is sufficient to attract notice and lead to its diagnostication.

When the hernia is reducible, the depth of the internal abdominal ring and the length of the inguinal canal are discoverable by tactile examination.

The importance of recognizing these cases.—It is highly important to recognize the cases of hernia into the vaginal process of

[1] On Ruptures, 5th edit., p. 574.

[2] Chirurgical Works, edit. 1808, vol. ii., p. 184.

[3] Icones Herniarum, tab. x., 1801.

the peritoneum, in a practical point of view, especially in relation to their treatment. Much more severe constitutional symptoms usually accompany strangulation in these cases, and this condition of the hernia takes place more rapidly than when the hernial sac has been of slow formation. They require, therefore, the liberation of the bowel as soon as it is possible.

Considerable difficulty is experienced in reducing these protrusions by the taxis, in consequence of the depth of the orifice of the sac, the inability of the operator to fix it or command its movements, the contraction of its orifice, its unyielding textures, and the length of the neck of the sac, or that part of it lying between the two inguinal rings within the inguinal canal. In cases of the hour-glass contraction of the sac, the taxis is generally useless if the bowel has been strangulated but a few hours, and persistence in such attempts is extremely hazardous. Under any conditions, the surgeon must remember that two distinct and separate contractions exist, through which the rupture must have passed; one of these being situated in the body of the sac, the other being its true ventral orifice. Either of these contractions, or both of them, may offer insuperable impediments to the reduction of the hernia, unless their tissues be cut.

If we scrutinize any large number of cases of inguinal hernia admitted into the hospitals, a majority of those requiring the liberation of the bowel by a cutting operation are patients under 30 years of age. At St. George's Hospital, out of 28 males suffering with strangulated oblique hernia, 17 were under 30 years of age; 11 had passed that age.[1] At Guy's Hospital, of 57 cutting operations performed in order to liberate a strangulated inguinal hernia, 33 belonged to the class of which we are writing, 24 were of the old slowly-forming variety. Next, in order to demonstrate with how much greater facility the old inguino-scrotal hernia is reduced by the taxis, than that descending into the vaginal process of the peritoneum, we may refer to 129 cases of oblique inguinal hernia, admitted also into Guy's Hospital. Of these, 59 had traversed the canal of the vaginal process of the peritoneum, 70 belonged to the old inguino-scrotal variety. Or, tabulated thus:—

Of inguino-scrotal, the sac of which formed slowly	94 cases	requiring a cutting operation . . .	24 or 25.53 per cent.
		reduced by taxis .	70 " 74.46 "
Of ing.-scrotal descending along the vaginal process of peritoneum	92 cases	requiring a cutting operation . . .	33 or 35.86 per cent.
		reduced by taxis .	59 " 63.04 "

Another subject of great importance relates to the application of the taxis. In some of those cases in which the hernia, when strangulated by the orifice of the sac, was supposed to have been returned into the abdomen in a mass, more careful examination after death showed that the inguinal portion of the sac was burst, and that the bowel had been pushed through the laceration, and was lying outside the peritoneum, between it and the internal abdominal fascia. This accident is more fully described at page 698. In these cases, also, the mouth of the sac is sometimes detached from its connections. When the patient is youthful, and the anæsthetic effects of chloroform are fully produced, great caution is, therefore, necessary in using the taxis, on account of the slight and delicate connections of the peritoneum to the neighboring parts at this early age.

Difficulties also attend the operations on these cases, in consequence of the depth of the orifice of the sac, the variable position of the testis, and the varieties which may be encountered in the disposition of the hernial sac, all of which have been before described.

Infantile hernia.—The infantile hernia of Hey, and the encysted hernia of the tunica vaginalis of Astley Cooper, are synonymous terms for a variety of the oblique inguinal hernia, depending likewise upon an abnormal condition of the tunica vaginalis peritonei. The state of that sheath which precedes the development of this kind of hernia depends upon the ventral orifice being closed, but the canal persisting from that point to the testis. The hernia slowly pushes before it the parietal peritoneum of the abdomen into this sheath, and when the parts are dissected, it is seen that "the tunica vaginalis is continued up to the abdominal ring, and encloses the hernial sac," as Mr. Hey describes. In this manner "the protruded parts, together with the sac, are contained in the tunica vaginalis testis" (Lawrence, A Treatise on Ruptures, p. 576).

The name given by Hey to this variety of hernia leads the reader to infer that it is always developed in infancy. This, however, is not the fact. Hey's case was

[1] Medical Times and Gazette, 1861, vol. i., p. 624.

an infant fifteen months old. Forster's case, related by Cooper, was thirty-one years old at the time of the operation. The duration of the rupture is not specially stated, but the description induces us to believe that it had not existed long. In Lucas's case the rupture was developed at about seventeen years of age. The man in Forster's second case had been ruptured all his life. Mr. Holmes reports a case in which the rupture was developed at about twelve years of age; and I operated upon a man in Guy's Hospital, forty-two years old, who was not ruptured until he had completed his thirty-fifth year.

Cases of this kind are very rare. Their precise nature is usually only detected during the time of the operation, when the surgeon finds that on cutting into the tumor, a serous cavity is opened, which contains the hernial sac, invested externally by a serous membrane. Within this, the true hernial sac, the rupture is found. The operator may also be a little puzzled by finding the tumor so remarkably movable, after he has incised the first serous sac. The whole tumor, with the testis attached to its walls, falls out, and seems to be only suspended by its attachment to the margins of the external abdominal ring.

Inguino-scrotal hernia of slow formation.—That variety of oblique inguino-scrotal hernia which occurs in middle and late adult life, and forms for itself its own sac by pushing the parietal peritoneum before it, causes at first a slight swelling at the internal abdominal ring, slowly traverses the inguinal canal, and at last occupies more or less of the scrotum. To the "pointing" of the hernia at the internal inguinal ring, as M. Malgaigne aptly terms it, the attention of the surgeon is sometimes drawn. Upon inspection a slight elevation of the integuments over the internal inguinal ring is observable, which becomes more prominent when the patient contracts the abdominal muscles or coughs, especially if standing erect. In this posture, and under similar influences, if the finger be placed over the ring, the hernia is projected against it, and the sensation thus induced is termed the impulse of the rupture.

At this period a truss should be constantly worn. If made to fit comfortably, it will prevent the further escape of the viscera; and by counteracting their propelling force against the parietal peritoneum, the development of the hernial sac is arrested.

As the hernia descends further from the internal inguinal ring, it produces a swelling in the inguinal canal. The long axis of the tumor is parallel with Poupart's ligament, and therefore follows the oblique direction of that firm, fibrous structure from above downwards and inwards. This bubonocele, as the tumor is usually called, is covered by the integuments of the groin and the aponeurosis of the external abdominal oblique muscle. Along its superior border it is overlapped by the free edge of the internal oblique and transversalis muscles; along its inferior by the cremaster muscle. It lies upon the internal abdominal fascia as it emerges at the internal inguinal ring, afterwards upon the conjoined tendons of the internal oblique and transversalis muscles, just before it reaches the external inguinal ring. Under these dispositions of the fleshy and tendinous fibres of the abdominal muscles, the hernial sac with its contents is in a very especial manner under the influence of their contractions; more especially in the region of its mouth and neck: hence a frequent impediment to the reduction of a hernia. The spermatic cord usually lies behind the tumor at the internal inguinal ring, and is attached to the posterior surface of the sac as it traverses the inguinal canal.

As the development of the sac advances, it is pushed through the external inguinal ring, over the os pubis, and into the scrotum. As the hernia points at the external inguinal ring, it forms a somewhat globular swelling; but as its bulk increases in its progress towards the fundus of the scrotum, the shape of the tumor is generally pyriform, when the scrotum is distended with the hernia. In the body of the tumor contractions or depressions, generally following an oblique or transverse direction, are occasionally observable. Such appearances are due to the more or less yielding tissues of the scrotum.

The testis is usually below the tumor, sometimes behind it. The elementary structures of the spermatic cord may be traced along its posterior or outer boundary, generally close together, side by side, but sometimes, though very rarely, separated from each other.

When the hernia is reduced, the forefinger may be passed with facility into the abdominal cavity through the external inguinal ring, the inguinal canal, much shortened, and the internal inguinal ring.

This is practicable on account of the approximation of those rings taking place from the pressure of the hernia and the relaxation of the surrounding structures. The mouth of the sac and the inguinal apertures are indeed sometimes so stretched that the finger may be freely passed to the abdominal surface of the symphysis pubis; and the pulsation of the epigastric artery, or of the external iliac, may be felt in the usual situations of those vessels.

A Tabular arrangement of the characteristics of the three varieties of oblique inguinal hernia in males.

A. Into the vaginal process of the peritoneum. (*Hernia congenita* Halleri.)	B. Into the funicular portion of the vaginal process of the peritoneum.	C. Inguino-scrotal; into the tissues of the scrotum.
1. Is developed most commonly in infancy; occasionally in youth; rarely in adult life.	1. Is developed frequently in infancy; often in youth and in adult life.	1. Occurs in adults, I believe, exclusively.
2. Is suddenly produced.	2. The same.	2. Is slowly produced.
3. At once descends along the inguinal canal into the scrotum.	3. The same.	3. By slow degrees traverses the inguinal canal and scrotum.
4. May rest in the inguinal canal when the testis is *not* in the scrotum.	4. May rest in the inguinal canal when the testis *is* in the scrotum.	4. May remain in the inguinal canal for an indefinite period, the testis being in the scrotum.
5. Envelops the testis, and lies in contact with that organ.	5. The testis, at the fundus of the scrotum, occupies its own serous sac, which separates it from the hernia. It usually produces a very distinct prominence at this part.	5. Is separate from the testis, which is at the fundus of the scrotum, usually.
6. The orifice of the hernial sac is contracted, and corresponds with the site of the internal abdominal ring.	6. The same.	6. Orifice of the sac large and near the external abdominal ring.
7. Neck of the sac long and tubular; it lies in the inguinal canal, between the rings, which are *not* approximated, even in the adult.	7. The same.	7. Neck of sac short, dilated; inguinal canal shortened; the rings *being* approximated.
8. Hernial sac a direct, congenital prolongation of the peritoneum; tubular when not distended with a hernia. It reaches the testis in the scrotum, and envelops it. Thus there is a congenital serous canal to receive the hernia.	8. Hernial sac, a direct congenital prolongation of the peritoneum; tubular when not distended with a hernia. It does not extend into the scrotum so low as the testis. A congenital serous canal exists to receive the hernia.	8. Hernial sac a new formation, and slowly developed by the pressure of the abdominal viscera against the parietal abdominal peritoneum, which by extension before the hernia is thus formed into a sac for it. Here the hernia forms its own sac by pushing the peritoneum before it. The tubular character of the sac is wanting.

Diagnostication.—Every inguinal hernia escapes from the abdominal cavity above Poupart's ligament. If, therefore, the tumor formed by an inguinal protrusion be examined whilst in the inguinal canal, Poupart's ligament is traceable along its inferior border, and the opening where the tumor seems to make its escape from the abdomen is above the same fibrous band. It may be always distinguished, then, from crural hernia; for that kind generally escapes through the crural ring, which is situated behind and below Poupart's ligament, and that ligament may be always traced along the superior border of the tumor. Figs. 420, 426 should be compared. [See also fig. 419.]

Again, an inguinal hernia reaches the scrotum through the external inguinal ring, the outer pillar of which is formed by the pubic attachment of Poupart's ligament to the spinous process of the pubes. Now place the tip of the finger upon the last-mentioned process of bone, and if the neck of the tumor lies to its inner side, or between the finger and the symphysis pubis, the tumor must be formed by a protrusion which has passed the external inguinal ring; a fact sufficiently demonstrative of an inguinal hernia. Should the tumor be to the outer side of the finger, the probability is that the hernia has passed through the crural ring.

Differential diaynostication.—The surgeon is often required to distinguish between inguino-scrotal hernia and some other tumors developed in the inguinal region and scrotum.

These are—1st, the different kinds of hydrocele; 2d, the encysted spermatocele connected with the epididymis; 3d, varicocele of the spermatic veins; 4th, inflammation of an old hernial sac, and the results of such inflammation; 5th, inflammatory affections and other diseases of the testis, the cord, and their coverings; 6th, hæmatocele; 7th, malpositions of the testis; 8th, inflammatory and other diseases of the inguinal lymphatic glands; 9th, growths of fat in the connective tissue of the inguinal canal and upon the spermatic cord; 10th, diseases of the integuments of the scrotum, especially growths, as elephantiasis.

The nature of these diseases being described in other parts of this work, the observations we have to make in relation to the differential diagnosis between them and inguino-scrotal ruptures may be condensed into a tabular form. This plan was suggested by the perusal of a chapter written by M. Vidal (de Cassis), entitled "Chronic tumors of the scrotum considered in a diagnostic point of view."[1]

To one variety of hydrocele it is perhaps necessary to make a special allusion. In rare instances serum collects in the vaginal process of the peritoneum, when its ventral orifice is patent, and the accumulated fluid may be pressed out of the scrotum into the peritoneal cavity through

Characteristics of the Reducible Tumors compared with Hernia.

	Their entrance or return into the abdomen.		Their passage from the abdomen.
	Characters in common.	Special characters: when without complications.	Special characters.
1. Inguinal hernia.	*All* return into the abdomen most easily when the patient lies down on the back and when the abdominal muscles are relaxed.	1. *Hernia* enters most readily. When once commenced, passes in quickly and suddenly. Entrance complete. Opaque and thick neck of tumor. Testis may or may not be perceptible until reduced. *No* vibration.	1. Is developed from above, descends when the patient rises or exerts the abdominal muscles, and more quickly than others. The finger pressed over the ring prevents its descent.
2. Hydrocele of vaginal process of peritoneum.	.....	2. *Hydrocele* of vaginal process of peritoneum enters slowly, and never suddenly. Entrance complete. Translucent and small neck of tumor. Testis imperceptible until the fluid has entered the abdomen. Vibration.	2. Seems to be developed from below upwards. The serum sometimes remains in spite of the horizontal position.
3. Hydrocele of funicular division of vaginal process of peritoneum.	.....	3. *Hydrocele* of funicular division of vaginal process of peritoneum enters like No. 2. Entrance complete. Translucent. Neck of tumor may pass into inguinal canal. Testis perceptible at fundus of tumor. Vibration.	3. Similar to No. 2.
4. Varicocele.	.....	4. *Varicocele* enters very slowly. Entrance not complete, the bulk of tumor only diminished. *No* vibration.	4. The tumor increases like hernia when the patient rises; but it increases also if pressure be made over the course of the spermatic veins in the inguinal canal, or if the blood be retarded in its passage along them in any way.

[1] Traité de Path. externe, edit. 1841, vol. v., p. 715.

that aperture. This condition usually occurs in infants, but we have seen it in adults, complicated even with a hernia. The differential diagnosis is stated in the table.

The chronic tumors of the scrotum may be arranged in two divisions:—

I. The reducible. (*See table on p. 724.*)

II. The irreducible. (*See table below, on this page.*)

In the first division there are:—

1. Inguinal hernia.
2. Hydrocele of the vaginal process of the peritoneum.
3. Hydrocele of the funicular portion of the same process.
4. Varicocele of the spermatic veins.

The tumors in the second division are composed very often of fluids only, sometimes almost exclusively of solids, but occasionally of both solids and fluids in variable proportions.

Those composed of fluids are—1, hydrocele of the tunica vaginalis propria testis; 2, hæmatocele in the same sac when first developed; 3, encysted spermatocele connected with the epididymis; 4, hydrocele of the spermatic cord.

Those formed by solids, or of solids and fluids, are—1, the diseases of the testis, *a*, of inflammatory origin, *b*, specific new growths; 2, hæmatocele of some standing in which changes have taken place; 3, diseases of the spermatic cord; 4, growths of fat extending from the inguinal canal into the scrotum or in its tissues; 5, diseases of the tissues of the scrotum.

Between the local signs of an inflamed scrotal hernial sac, especially if its orifice be plugged by omentum, and an inflamed hernia, there is a close resemblance. But from the history of the case, and the absence of those constitutional symptoms which accompany an inflamed hernia, a correct diagnostication may be formed.

The inflammatory conditions of the testis, the cord, its coverings, and the tissues of the scrotum, do not resemble hernial tumors either in their local or constitutional manifestations. It is more probable that a hernial protrusion might be considered to be some affection of those organs, than that they should be mistaken for a hernia. The history of the case usually removes all doubt as to its nature.

Characteristics of the Irreducible Tumors as compared with Hernia.

Disease.	Weight.	Translucency.	Fluctuation and vibration.	Relation of testis to tumor.	Figure and development.	Size.	Consistence.	Pain.
HERNIA.	Lighter than either the fluid or solid tumors.	Very rarely so; generally opaque.	Only when fluid coexists with the hernia.	Position variable, but the testis usually discoverable.	Pyriform, but with *thick* neck. Occasionally globular or ovoid. Outline regular. Begins at neck of scrotum and descends.	Variable; at times very large.	Soft and yielding, except it be omental.	Painless unless diseased.
FLUID TUMORS.	Hæmatocele rather heavier than hydrocele.	Hydrocele particularly so. In rare cases opaque. Hæmatocele opaque.	Distinct; vibration very characteristic, as in hydrocele.	Perceptible in spermatocele; not in hydrocele of tunica vaginalis propria testis, usually.	Pyriform, but with very thin neck. Outline very regular. Globular as hydrocele of spermatic cord. Oblong as in spermatocele, and nearly transverse to vertical axis of scrotum. Begin near fundus of scrotum and ascend.	Rarely very large.	Yielding and elastic. Exceedingly incompressible as hydrocele of cord.	Painless, unless testis be squeezed, usually.
SOLID TUMORS.	Generally heavier than fluid.	Opaque.	Absent.	Often involved and imperceptible tho' its site may be discoverable by pressure.	Outline of testis often preserved. Sometimes surface irregular.	Large; steadily increasing.	Resisting, firm and rarely hard.	Painful, but variable in degree.
MIXED TUMORS.	Heavy.	Sometimes in parts of them.	In some parts, not in others.	Involved.	Irregular outline.	Large; at times rapidly increasing.	Resisting in parts, soft in others.	Variable.

Treatment.—The palliative treatment of reducible oblique inguinal hernia consists in maintaining perfect and unintermitting retention of the hernia; for if this be done carefully and with method, a permanent cure may be effected, especially in children. The cases of hernia into the vaginal process, if carefully treated immediately after the first appearance of the rupture, and before the walls of that canal have been stretched for any length of time, are sometimes cured by the employment of a well-adjusted truss. But in the use of this instrument before puberty, great attention must be given to the site of the testis; for the pad of the

truss might press injuriously upon that organ. The spring of the truss must not be too powerful; for if the pressure of the pad upon the walls of the abdomen is very strong, their tissues are absorbed where the pad presses, and they become, in consequence, seriously weakened. The pad should prevent the escape of the hernia by its accurate adjustment, rather than by the force with which it presses against those apertures through which the hernia passes. On this account, each individual requires to have a truss adapted to the configuration of the body. The pad should be applied over the internal inguinal ring, pressing gently upon the inguinal canal to afford support to the tissues of that part, and not upon the external inguinal ring and pubes, as we have often seen it applied. The patient should be enjoined to wear the truss uninterruptedly, except only when lying in bed; to adjust it carefully before leaving bed in the morning, and on no account to permit the hernia to remain for a moment in the sac.

When the hernia has acquired large dimensions, or has become irreducible, a particular form of appliance, termed the bag-truss, becomes indispensable.

The radical cure of reducible inguinal hernia.—The mode of performing the operation as practised by Wutzer is as follows (a special instrument is required, which consists of two pieces of wood and a flexible needle):—

The patient being placed in the most favorable position, and the rupture carefully reduced, the forefinger of the operator is used to invaginate the integuments and to push the fundus of the sac into its orifice. The cylindrical wooden plug is next inserted in place of the finger, and the needle thrust through the invaginated skin, sac, anterior wall of the inguinal canal, and skin of the groin. The grooved piece of wood is then laid over the inguinal canal, held in position by the needle, and screwed tightly to the first piece, in order to induce adhesion between the tissues thus compressed between them. The plug is retained for seven or ten days, according to circumstances: after its removal, a pad should be adjusted to support the part, and prevent the extrusion of the invaginated tissues.

The commonly unsuccessful issue of the operations performed on the principle of invagination, as advocated by Gerdy, Wutzer, and others, induced Mr. Wood to search for the cause of failure. This he attributes to the want of union between the invaginated tissues and those lying behind them. The theory of Wutzer's operation is to induce adhesion between the fundus of the hernial sac and the entire circumference of its orifice, as well as entire obliteration of the other parts of the sac by adhesive inflammation. Unfortunately, however, the results of practice do not uphold the theory.

Mr. Wood[1] has contrived an operation by which he believes the chances of failure above mentioned are prevented. The operator requires a special needle, scalpel, compress made of wood, glass, or porcelain, and some strong hempen thread. The contraction of the abdominal muscles should be completely controlled by the influence of chloroform [ether].

After an incision has been made through the skin of the scrotum, the forefinger of the operator is pushed behind the hernial sac as far as possible into the inguinal canal, and in front of the spermatic cord, at the same time invaginating the tissues. The needle is next carried by the side of the finger and passed through the conjoined tendons of the internal oblique and transversalis muscles, the inner pillar of the external inguinal ring, and the integuments. Great care is required to avoid including the spermatic cord. A thread is next passed through the eye of the needle, and the latter is withdrawn, leaving one end of the thread in the puncture. The needle, still threaded, is next passed through the aponeurosis of the external abdominal oblique muscle near to Poupart's ligament, and opposite to the internal inguinal ring, and its point brought out through the opening in the integuments first made by it. A loop of thread is left behind, and the needle, with the thread still in it, is again passed through that portion of the conjoined tendons which lies over the rectus muscle, close to the pubic spine and the inner pillar of the ring. Its point is now brought through the first puncture for the third time, and the needle altogether withdrawn from the thread.

Thus a loop and two ends of thread pass through one opening in the skin. "Two portions of thread are thus placed across the hernial canal, invaginated fascia and sac, closely embracing, but not including, the spermatic cord, and connecting the posterior or deep wall with the anterior and superficial, perforating the aponeurosis of the external abdominal oblique muscle in three places; but escaping by the same aperture in the skin" (Wood). The compress is next applied over the canal obliquely, and the two ends of the thread passed under the loop and tied in such a manner as to give equable adjustment to the pressure.

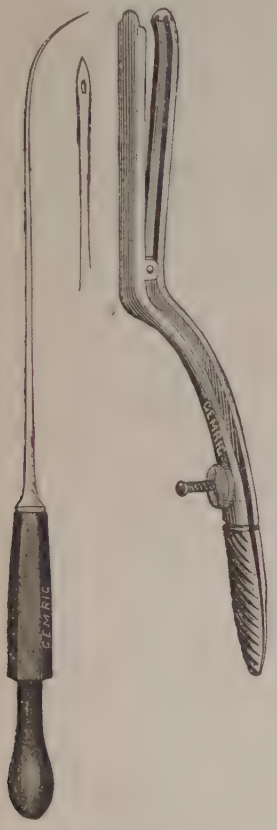
The after-treatment of the case is the same as that adopted in similar operations.

[1] On Rupture: Inguinal, Crural, and Umbilical, etc., by John Wood, 8vo., London, 1863.

Mr. Wood describes several modifications of this operation in which wire was used with good results.

[A plan which has found some favor in this country, and which I have used with success in three cases, is known as Agnew's. The instruments required are shown in fig. 423. The skin being divided,

Fig. 423.

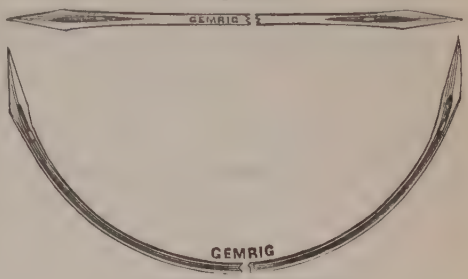


Agnew's instruments for the radical cure of hernia.

the fascia and subjacent tissue are pushed up into the inguinal canal as far as possible, and the bivalve plug, closed, is then substituted for the finger. Next the long needle is passed up through the groove on one side of the lower blade, and out at its tip. A suture of silk or fine wire is inserted in the eye; the needle is then withdrawn, and carried up through the other groove, and out. Thus the end of the inverted pouch of tissue (not skin) is sutured in its new position. Now, the blades of the bivalve plug being kept widely opened, sutures are passed across between them, and secured about bits of catheter on either side. The plug is now carefully withdrawn, and the sutures left in place as long as may seem desirable. A dressing of laudanum, or lead-water and laudanum should generally be applied after the operation, to allay pain.

Dr. Greensville Dowell's needles are shown in fig. 424. His plan of operation, which is quite ingenious, can hardly be detailed here, but is given in full in his book on the subject.

Fig. 424.



Dowell's hernia needles.]

The taxis.—When a surgeon has a case of irreducible inguinal hernia to treat, his attention should be particularly devoted to a very careful examination of the tumor, in order to diagnosticate the variety under observation. He should ascertain with accuracy the anatomical relations of the tumor to the surrounding parts; the position of the testis, especially; the length of time the patient has been ruptured; the mode of development of the hernia, whether suddenly or slowly; the treatment pursued to prevent the protrusion from taking place; and the history of the present state of the rupture.

Having determined the variety, if the state of the tumor permit, he may employ gentle pressure in order to reduce the protrusion, remembering the direction or course it has taken, and the circumstances which probably cause the impediment to its reduction. The abdominal muscles must be relaxed as much as possible whilst the patient lies on the back.

It is only necessary to describe, in this place, the manipulative proceedings, as the constitutional measures employed to render them more effective have been detailed at page 694. A very much larger proportion of the cases of inguinal hernia are now reduced by taxis than formerly. This is due to the use of chloroform [or ether], the effects of which in producing total annihilation of the contractile function of muscular tissue are so important. Small inguino-scrotal protrusions are not reduced with the same facility as large ones. When such a protrusion occurs in a young person, and has been only recently developed, after a fair trial of the taxis, when the patient is fully under the influence of chloroform, and the efforts to reduce it have failed, any delay

in removing the impediment to the replacement of the hernia is reprehensible. To resort to any other measure which necessitates the occupation of time, is only to abandon the sufferer to additional risk of the loss of life. [Mr. John Duncan relates (Edinb. Med. Journal, Nov. 1873) a case of large scrotal hernia reduced by means of an elastic bandage carefully applied. He credits Maisonneuve with the origination of the idea.]

If the protrusion be compound, that is to say, when it consists of a large mass of omentum and a very small knuckle of bowel, the reduction of the latter is effected with difficulty. The same thing occurs when the hernia is one of irreducible omentum of long standing, from old adhesions, and a small piece of bowel. Also, when the sac is distended and rendered very tense by a considerable effusion of serum. The efforts of the surgeon to reduce the bowel are thereby rendered abortive; for if the serum cannot be made to pass through the mouth of the sac, into the abdomen, the hernia never will.

The operation.—The patient should lie on the back, with the pelvic region slightly elevated, unless some firm, resisting body, as a mattress, cushion, or table, be underneath. The anatomical points which the surgeon particularly wishes to reach or display in the cutting operation are, the external inguinal ring, the aponeurosis of the external abdominal oblique muscle, the internal inguinal ring, and the mouth of the hernial sac. The various structures which constitute the coverings of the hernial sac need not be displayed with rigorous anatomical precision. They differ exceedingly in density and development in different cases. The length of the incision should not be proportioned to the size of the hernia. Its length must be just sufficient to expose freely the anatomical points alluded to above, and no more. In ordinary cases, the point of the scalpel should be inserted through the integuments at about one to two inches above the assumed centre of the external inguinal ring, and carried downwards upon the anterior surface of the tumor, to terminate about two or three inches below the same mark. The margins of the external inguinal ring are next carefully exposed, and their relations to the tumor examined. They should not be cut unless it be imperatively required to do so. The deeper coverings of the hernial sac are next carefully incised, with or without the assistance of a grooved director, until that important structure is reached.

The operator, pressing his finger upon the sac, next insinuates it [the finger] through the external inguinal ring, in order to ascertain if there be any structures which firmly encircle the neck and orifice of the sac outside. Should he discover any, a grooved director may be guided by the finger underneath them, and they may be cut. After slight pressure made upon the sac, its contents are sometimes returned into the abdomen at this stage of the operation. If their reduction be not practicable, the peritoneal sac must next be opened. It must be done after the manner described at p. 700, and with great care. Probably some serum will escape when the sac is cut, but this is not always the case. The opening in the sac requires to be sufficiently large to allow the operator to reach its orifice easily, and to examine its contents. The index finger is now passed along the anterior surface of the protrusion upwards towards the mouth of the sac, when an impediment to its further passage is encountered. The tissues which bound this narrow opening constitute the impediment to the reduction of the hernia. The operator next passes the hernia bistoury along a grooved director, or upon his finger, through the mouth of the sac, and divides the structures in contact with the knife sufficiently to allow the ungual phalanx to be passed freely into the abdominal cavity. The direction of this incision should be parallel with the linea alba. A few small arteries are occasionally cut during the operation, which may be twisted immediately before further proceeding.

Oblique inguinal hernia in the female sex.—This variety occurs at very early periods of life. In fact, with the exception of umbilical hernia, it is the only kind developed before five years of age. Even until the age of puberty it is more common than any other variety. Its development in infancy is due to the patulous state of the vaginal process of the peritoneum, otherwise known by the name of the canal of Nuck. Doubtless such a condition of this process remains throughout early life, into which a hernia occasionally and suddenly descends. In the adult female this hernia generally forms slowly after thirty years of age. But I have met with double inguinal hernia in a well-formed woman aged only twenty-four years, who had never been pregnant; she had worked hard, however.

Its anatomical relations are alike in both sexes, merely substituting the round ligament in the female for the spermatic cord of the male, and the labium pudendi for the scrotum.

It is commonly believed that inguinal hernia is much more rarely met with in women than femoral. However, this belief seems to be founded on an error. Mr. Kingdon's valuable tables show that in

the years 1860 and 1861, 1582 females at all ages, suffering with either one variety of hernia or the other, came under his observation. Of these, 761 were afflicted with inguinal hernia, and 821 with femoral. Or, inguinal hernia was only thirty less than half the total number, whilst femoral was but thirty more than half. Mr. Kingdon told me this year that it is not uncommon to feel the ovary in the sac of an inguinal hernia of an infant.

[In the Transactions of the Obstetrical Society of London, vol. xxi., 1879, Mr. Thomas Chambers reports a case of double inguino-ovarian hernia in a *woman*, æt. 24, in which the swellings were becoming larger and more painful every year, and were removed, when examination with the microscope showed them to be undeveloped testes. (See Am. Journ. of Med. Sciences, October, 1880, p. 504.)

A yet more remarkable case is quoted in the Brit. Med. Journal, Jan. 3, 1880, as reported by Dr. Leopold in the Arch. für Gynækologie, vol. xiv.; here a left inguinal hernia was found to contain the upper section (segment?) of a small uterus." The uterus, ovary, and Fallopian tube were removed; the pedicle ligatured and returned; and the patient did well.]

The tumor formed by an inguino-labial hernia rarely attains the size so often reached by inguino-scrotal. Still, we have seen one which descended more than halfway below the middle of the thigh, and the coverings of which had become so attenuated that the convolutions of the intestines were distinctly visible. When of moderate size, it is generally of a more globular figure, and it has a longer and more contracted, or more narrow and cylindrical neck, than in the male sex.

In forming a correct diagnostication of this hernia in the female, the same anatomical points must be taken as guides which have been already described when that in the male sex was under consideration. The surgeon should, however, particularly remember that a hydrocele of the round ligament, or of the canal of Nuck, is occasionally developed, which might lead to an error in diagnosis.

The palliative measures described as being suitable in the treatment of cases of inguinal hernia in the male sex are applicable in these also; but if the hernia become strangulated, the surgeon must regard the accidents arising from misapplied taxis, and delay in liberating the bowel, with very great suspicion, and act with promptitude and decision. In the cases we have seen, under these circumstances, the symptoms have usually been rather severe at an early period of the attack; and in those upon which we have been required to operate, the impediment to the reduction of the bowel was at the orifice of the sac, and certainly insuperable without a cutting operation.

In the female sex, the operator must be guided by the same anatomical points in his attempt to reach the mouth of the hernial sac as in the male. And he should remember that, occasionally, although very rarely, the bowel may be constricted by a contraction of the sac itself near the external inguinal ring, and not by its ventral orifice only.

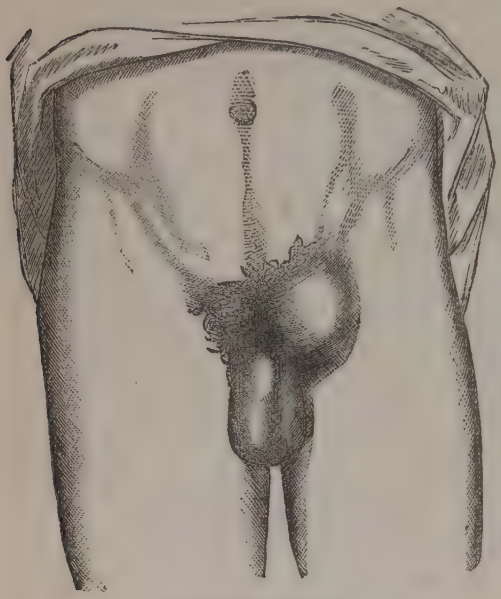
Direct inguinal hernia.—The variety of inguinal hernia characterized by the term "direct" occurs in both sexes. It belongs to that class in which the hernial sac is formed slowly, or is an accidental or acquired formation. The only exception to the slow mode of formation is in those rare cases when the structures immediately behind the external inguinal ring are lacerated by violence and a hernia protrudes. It is never the result of a congenital imperfection. This variety is sometimes styled the internal inguinal, from the fact that the mouth of the sac, where it is continuous with the parietal abdominal peritoneum, is placed to the inside of the internal epigastric artery. It is comparatively rare.

At its commencement it forms a prominence where it points behind the external inguinal ring, through which it passes into the upper part of the scrotum. The outline of the tumor which it forms is more globular than that produced by the oblique course of the variety before described. It seems to be produced by something which escapes at once or directly from the cavity of the abdomen. Hence, probably, its specific name. The mouth of the sac is close to the outer border of the pubic attachment of the rectus muscle, the posterior surface of which may be much more easily felt when the hernia is reduced than in the oblique variety. On the outer side of the orifice of the sac the pulsations of the internal epigastric artery may be felt. The finger enters the abdominal cavity much more readily in direct inguinal hernia than in oblique. Upon ocular examination from a short distance it will be seen that a line passing through the vertical or long axis of the tumor lies parallel with the linea alba, and there does not appear to be any inclining or curving of the neck of the tumor outwards and towards the crest of the ilium, as is observed in one formed by oblique inguinal.

In its passage from the abdomen a direct hernia merely traverses that small portion of the inguinal canal which lies immediately behind the external inguinal

ring, and those structures which form that part of the floor of that canal are either pushed before the hernia, or they are lacerated when the hernial sac escapes through the opening so formed. Those structures are the conjoined tendons of

Fig. 425.



Direct inguinal hernia.

the internal oblique and transversalis muscles and the pubic portion of the internal abdominal fascia. The spermatic cord and round ligament are not attached to the hernial sac until it has reached the external abdominal ring. When it has passed that point, they lie to its outer side, and are usually less identified with its tissues than in the oblique variety.

The diagnostication between this variety of inguinal hernia and oblique must be formed under the guidance of the facts before described.

The palliative treatment requires a particular kind of truss, which must be so constructed as to give support to the defective abdominal walls posterior to the external inguinal ring.

The method of exposing and opening the hernial sac to liberate a strangulated bowel does not require any special description here. Facts, however, worthy of note are, that after the division of those structures superficial to the external inguinal ring, the spermatic cord may appear to be unusually distinct, and that the deeply-seated coverings of the hernial sac are often very attenuated. Considerable care is therefore required in the operation of incising them.

Inguinal herniæ sometimes pass through abnormal apertures in the aponeurosis of the external abdominal oblique muscle.—It would be an oversight not to allude to the fact, that an inguinal hernia sometimes passes through an opening or division of the fibres in the aponeurosis of the external abdominal oblique muscle close to the ring, and not through the true external inguinal ring, which is then traversed by the spermatic cord alone. Such anatomical varieties are rare, and would only require some slight modification of the operation, to meet their peculiarities.

Femoral hernia, also called crural or merocele, was not accurately distinguished from some forms of inguinal until the middle of the 17th century. Its designation in a measure indicates the region of the body where it forms a tumor, which, however, may be stated, with greater precision, to be the upper and inner part of the thigh. Its anatomical relations were not accurately defined for many years after it was known to pursue a different course to inguinal; and it is curious to follow the gradual development of our knowledge of those structures immediately interested in, or associated with, this variety of rupture.

The principal anatomical points which should be examined, from the outside of the thigh as well as from within the abdomen, are the following: the ligament of Fallopius or of Poupart: Gimbernat's ligament; the crural canal or ring; the fascia transversalis and iliaca, or the internal abdominal fascia of the iliac fossa; the falciform process of the fascia lata, and the saphenous opening; and, when a hernial sac exists, the fascia propria of Sir Astley Cooper.[1]

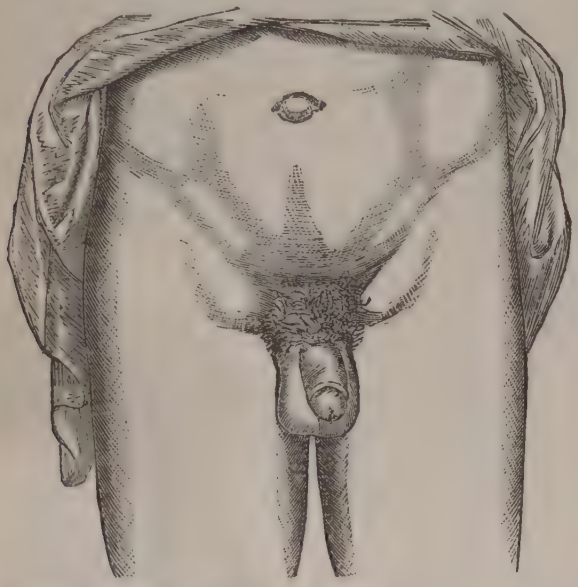
Relations of the mouth of the hernial sac to the internal epigastric artery and vein.—The orifice of the peritoneal sac holds important relations to the internal epigastric vessels. Some pathologists have established three varieties of the ordinary kind of crural hernia on this basis. The first,

[1] The anatomy of these various parts must be assumed to be known by the reader. We may, however, allude here to the importance of noticing the structure last named, viz., the fascia propria, first described by Sir Astley Cooper from a dissection made in 1800, and which is still preserved in the Museum of Guy's Hospital (No. 2503). It is an envelope which is found on the outside of the peritoneal sac, usually separated from it by a layer of adipose tissue.

in which the orifice of the sac is situated to the outer side of the epigastric, external crural hernia; the second, where it lies to the inside of the same vessels, the middle crural hernia, the most common; the third, in which it is placed to the inner side of the remains of the obliterated umbilical artery. The first and third varieties are very rare.

Here we may also state that the obturator artery is occasionally given off from the internal epigastric or femoral, and that when the former vessel lies to the outside of the orifice of the hernial sac,

Fig. 426.



The illustration represents double femoral hernia. The outline of Poupart's ligament being remarkably distinct *above* the tumor formed by it.

the obturator artery may cross closely over its neck, and dip down by its inner side to enter the obturator foramen.

A very interesting case, with a well-drawn illustration, is recorded by Mr. Spence in the Edinburgh Medical Journal, July, 1855. The pulsation of a large vessel was felt with the finger before its division.

[The obturator artery arises from the internal iliac in 2 out of every 3 cases; in one case in 3½ from the epigastric; and in about one in 72 cases by two roots, one from each vessel (Gray). In the first case, it runs along the pelvic fascia, just below the pelvic brim, to pass out at the obturator foramen, and does not concern femoral hernia at all. In the second and third, it may pass down either on the outer or inner side of the femoral ring; if, on the outer, it will not be endangered by the incision of the stricture in the usual way, inwards. But if it passes down on the inner side, it will be very apt to be divided unless the precaution is taken of feeling for its pulsations, and avoiding it if it is felt. A case of this kind was reported by Mr. Barker to the Clinical Society of London (Med. Times and Gazette, May 25, 1878); and others are upon record. Dr. Shepherd (Montreal General Hospital Reports, 1880), says that in 28 cases in which the obturator arose from the epigastric, it passed on the inner side of the ring in two only.

The reader is referred to fig. 419, p. 712, for a clearer idea of this subject.]

Varieties in the course pursued by the sac of a crural hernia.—In a memoir published by Dr. Le Gendre, he describes four rare varieties of crural hernia.[1] They may indeed be regarded rather as curiosities, on account of their rarity.

1. The hernia, as soon as it traverses the crural ring, passes directly internal to and behind the femoral vessels, and rests on the pectineus muscle, the aponeurosis of which sometimes forms an envelope to it; this he calls the pectineal crural hernia, on account of its situation, or the hernia of Cloquet, in honor of the surgeon who was the first to describe it. Callisen, Vidal (de Cassis), M. Richet, Dr. Le

[1] Mém. sur quelques variétés rares de la Hernie crurale; avec 6 planches, 8vo., Paris, 1858.

Gendre, and Mr. J. Adams,[1] have recorded similar cases.

2. This variety, although placed internal to the femoral vessels, is, however, rather far from them; it passes through that resisting fibrous structure which bounds the crural canal and sheath internally; that is to say, the ligament of Gimbernat. Laugier, who was the first to notice it, calls it the *crural hernia through Gimbernat's ligament*, or the hernia of Laugier. Cruveilhier, Demeaux, Nuhn, and Le Gendre have also dissected cases of this kind.

3. This comprehends the variety of crural hernia which Hesselbach has so well described and figured.[2] The hernia in this case traverses several openings in the fascia cribriformis, and then presents several distinct lobes, which give it a characteristic appearance; it is *the hernia with a diverticulum through the cribriform fascia*, or the hernia of Hesselbach. Le Gendre and Malgaigne have dissected examples of this variety of rupture, which the former believes to be not so very rare.

4. Lastly, a variety in which the hernia, after having escaped beneath Poupart's ligament and traversed the cribriform fascia, sends one or more prolongations through the superficial fascia. This variety may be termed *the crural hernia with a diverticulum through the superficial fascia*, or the hernia of Astley Cooper.[3] Le Gendre describes a dissection of a case of this kind, and publishes a drawing of it in his work.

We may add a variety described by Mr. Partridge,[4] in which the hernia was situated external to the femoral vessels.

Development of the sac of a crural hernia.—The peritoneal sac of a crural hernia is always a secondary or acquired formation. It is never the result of a congenital defect. An opportunity of observing the early stage of a crural hernial sac commonly occurs in post-mortem examinations. The point of the finger may be pressed into a fossa, or even a sacculus, of two or three inches in length, between the femoral vein and Gimbernat's ligament. An observer is enabled, in this way, to thrust the parietal peritoneum down upon the thigh at this spot for an inch or more below Poupart's ligament. And this opportunity is most favorable for the study of the relations of the sac of a crural hernia. By degrees such a digital depression of the peritoneum at the crural ring becomes in a living person dilated into a sac by the repeated and continued pressure of the viscus which forms the hernia. The sac extends lower down upon the thigh beneath Poupart's ligament; but, instead of descending lower and lower towards the knee, it usually dilates in a direction towards the crest of the ilium, so that the long axis of the tumor lies parallel with Poupart's ligament and upon the fascia lata. When large, the tumor even overlies that ligament, and seems to occupy the region in front of the inguinal canal. But in every case of crural hernia the tumor is formed by a protrusion which has escaped from the abdominal cavity below and behind Poupart's ligament; therefore the surgeon is able to trace that structure running along its upper border.

Fig. 427.

A piece of the ileum about three feet from the cæcum removed from a patient, aged fifty-seven, who had been operated upon for strangulated femoral hernia of seventy-three hours' duration. She survived the operation forty hours, and the first symptoms of the attack 118 hours. She had been in bad health previously, was extremely emaciated, and sank from exhaustion. Large and hard masses of scybalæ were found in the ileum, as shown in the part of the bowel cut open. The small piece of bowel which had been in the sac, and was but little diseased, is indicated by the dotted line. The contracted and opened bowel below this contained mucus only.

The figure in the centre represents the sac. Through its mouth a piece of glass rod is inserted; and although the sac is very small, it was remarkable for the layer of fat, *b*, between the peritoneum, *c*, which is not cut, and the fascia propria, *a*. (Museum Guy's Hospital; No. 4775.)

Crural hernia rarely increases to the size of inguinal. But occasionally, after an operation for the liberation of a stran-

[1] Med.-Chir. Trans., 1860, p. 127.

[2] De ortu et progressu Herniarum, 4to., 1816.

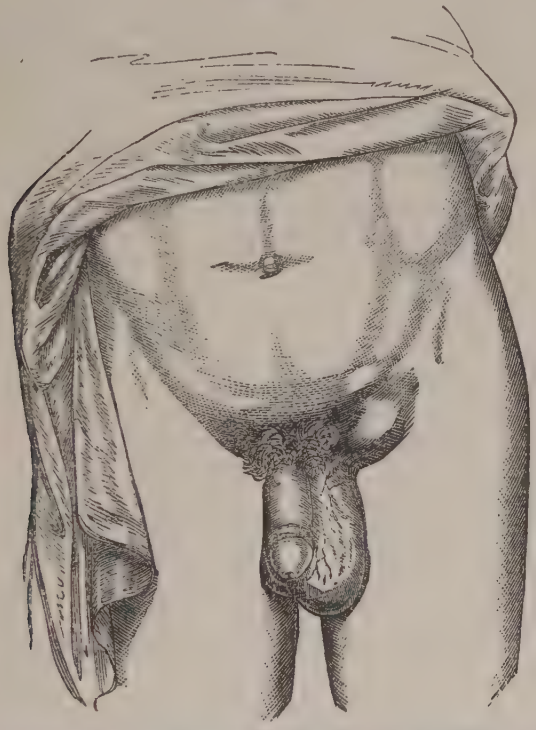
[3] Anatomical and Surgical Treatment of Abdominal Hernia, chap. xx.; case of Mrs. Sheffield.

[4] Trans. Path. Soc., vol. i., p. 99.

gulated bowel, when the tissues around the crural aperture have been weakened by cutting them, and the sufferer has neglected to employ the support afforded by a truss, nearly the whole of the alimentary canal may protrude. In such cases the walls of the sac become so remarkably attenuated that the peristaltic movement of the intestinal convolutions is distinctly seen through them; so attenuated as even to excite astonishment that the vitality of the integuments should be maintained. A very rare variety, as regards figure, we once saw in a man. The tumor was of a cylindrical shape, and extended downwards and inwards over the thigh, reaching as low as the middle of that region. The great size of the tumor is not a feature of serious importance, for a very small sac, having a contracted orifice, more readily entangles the hernia and prevents its reduction.

Diagnostication; first, from other kinds of hernia. Those with which crural may be confounded are inguinal above Poupart's ligament, and obturator below the horizontal ramus of the pubes. It would seem to be impossible, however, to mistake a crural hernia for an inguinal, or *vice versâ*, if the observer will but carefully trace the outline of Poupart's ligament. But he must remember that the fundus of the sac of a crural hernia sometimes takes a course upwards, and overlies that structure. Nevertheless, the course of Poupart's ligament can be always

Fig. 428.



Demonstrates the appearances produced by a small inguinal hernia just pointing at the external inguinal ring, and a medium-sized femoral hernia, both on the same side, and the outline of Poupart's ligament between those tumors. On the left side of the scrotum a tumor is produced by hydrocele of the tunica vaginalis testis. (From nature, and copied from a drawing in Guy's Hospital Museum.)

ascertained with more or less precision; whether an inguinal hernia overlies it from above—a very rare occurrence—or a crural from below, which is very common, the fingers of the examiner can still trace it from the ilium to the pubes—of course, in one case more distinctly than in another. If the whole of the tumor lies below the ligament, and its neck can be traced continuous with the crural aperture, its contents have escaped beneath Poupart's ligament, and it is a crural rupture; but if the contrary, it is an inguinal, especially, too, if the neck be traceable to the internal inguinal ring. Crural is distinguishable from inguino-labial hernia by placing the finger on the spine of the pubes, or upon the attachment of the tendon of the adductor longus into that point of bone; for even in very fat

persons the pubic spine can be always felt. If the tumor be to its outer side, the protrusion has escaped below Poupart's ligament, in which case it is crural rupture; if, on the contrary, it has passed through the external inguinal ring, it must be an inguinal. The same point of bone will aid in distinguishing between a pudendal hernia and a crural.

A crural hernia is much more superficially seated than an obturator, and in consequence the tumor which the latter produces is neither so prominent nor so well defined as the former. The latter escapes from the pelvis behind the horizontal ramus of the pubes, and therefore Gimbernat's ligament and the crural aperture can be felt. The elevation of the integuments produced by an obturator hernia is certainly in the locality of the crural aperture; but the depth of the tumor is its striking feature, and the facility with which the crural aperture can be felt is pathognomonic of the relations of the protrusion.

Crural hernia requires to be distinguished from other diseases which occur in the same region.

1. From *psoas abscess.*—The history of the case, the locality of the swelling, and the results of a palpable examination of the tumor, are quite different from hernia. Psoas abscess is generally preceded by pain in the back, constitutional disturbance, and inability to extend the hip-joint completely without pain. These symptoms do not accompany a crural hernia. Psoas abscess does not burrow down below Poupart's ligament at the crural ring, but to the outer side of the sheath of the femoral vessels. But an infallible test that the tumor is formed by a circumscribed collection of fluid is obtained by placing the patient flat on the back, and then gently applying the right hand above Poupart's ligament and the left below it, or *vice versâ*. When pressure is made upon the swelling with one hand only, the other is elevated; and when the action is reversed, the opposite effect takes place. With this result on manipulation of the swelling, there can be no doubt of the nature of the disease.

2. *Enlargement of the lymphatic glands.*—The correct history of the development of the swelling will aid in forming the diagnosis, especially its permanence and progressive increase. If there be a suspicion that the tumor is of glandular origin, it is as well to institute a careful examination of those somewhat secluded regions in which certain specific ulcerations unfortunately occur, giving rise to angioleucitis.

3. *Dilated and varicose veins.*—We have seen a dilated vein and tumor formed of varicose veins occupying the site of a femoral hernia; but the diagnosis was easily made by placing the patient in a recumbent posture, when the swelling disappeared. Digital pressure being made at the crural ring, or upon the vein, the swelling was at once reproduced.

4. *Cysts* in the superficial fascia. Cysts are sometimes, although very rarely, developed in the region of the crural ring, in some cases associated with hernia, but sometimes without. The permanency of the swelling, its persistent and invariable size, the fluctuation discoverable on pressure, and the history of the case, are aids to correct diagnostication. When a cyst is present, and there are any symptoms suggestive of strangulated bowel, the propriety of accurately ascertaining the contents of the tumor by an exploration of its interior cannot be disputed.

Palliative treatment.—The treatment of crural hernia by the use of trusses is most important. The prevention of the dilatation of the sac is the primary point to which attention should be directed; and this may be accomplished by giving support in the region of the crural ring, especially if it be efficiently maintained.

We gladly avail ourselves of the large experience of Mr. Kingdon in offering a few observations regarding the use of trusses in this variety of hernia. In a truss to prevent the escape of a crural hernia, the spring should fall somewhat suddenly from the point where it passes around the hip, and lie along Poupart's ligament. The pad should be rather small and convex. The cross-strap should fasten high up on the shoulder of the spring, in order to keep the pad well down in the thigh. The thigh-strap should start from near the pad, and return, after encircling the thigh, to the pad itself. When Poupart's ligament, or rather the whole crural arch, is lax, and moves backwards and forwards with the varying size of the abdomen, the pad should press upon that ligament; for then the crural aperture is made smaller, and the rupture more efficiently maintained. For that purpose a larger and flatter pad is wanted. But when the crural arch is strong and steady, the smaller pad is both more effective and, by reason of its smallness, more convenient and less incommodious. Also, it is less liable to displacement by the movements of the hip-joint.

When the rupture is large, or where it comes down under the fascia lata, it is necessary to use a thigh-belt, with a triangular pad projecting on the inner surface, and forming a soft continuation of the pad, to fill the triangular space where the cribriform fascia occupies the saphenous opening of the fascia lata.

Sometimes after an operation, in which Gimbernat's ligament has been freely divided, a cross tongue in addition, to buckle to the free end of the truss, is needed.

Irreducible crural rupture of course requires a hollow pad, whether epiplocele purely, or enterocele.

Attempts have been made to effect a radical cure of crural rupture by a cutting operation. The patients recovered from its effects; but we have no data by which to arrive at any conclusion as regards the advantages obtained.

Crural hernia very rarely occurs before puberty. I have seen one in a girl ten years old.

Crural hernia is much more common in the female sex than in the male. But the general belief, that it is much more common in women than inguinal, does not appear to be founded on facts. The following table demonstrates the proportions in which they occur. The comparative numerical equality is explained by the circumstance, that before puberty inguinal hernia is common, whilst crural is extremely rare. In 193 girls before 15 years of age, Mr. Kingdon met with 184 cases of inguinal rupture, and only 9 of crural. Even to the age of 20 years, the cases of inguinal hernia are much more common than femoral, as the subjoined table shows. In a total of 1442 ruptured females, at all ages from birth upwards, the majority of the cases of crural hernia over inguinal was only 54.

After twenty years of age, crural hernia is much more commonly developed than inguinal.

Decades.	Inguinal.	Femoral.
Birth to 10 years .	146	1
11 to 20 " .	103	37
21 to 30 " .	153	180
31 to 40 " .	164	252
41 to 50 " .	76	158
51 to 60 " .	33	84
61 and upwards .	19	36
Total . .	694 +	748=1442 cases.[1]

Total cases of femoral	748
Deduct cases between 20 and 40 years .	432
At all other ages	316
Deduct cases before 20 years of age .	38
After 40 years of age	278

This table demonstrates a fact for which the pathologist will be scarcely prepared, viz., that the largest number of cases of crural hernia is developed during those years usually termed the prime of life, *i. e.*, in women between twenty years old and forty.

[1] This table was made from Mr. Kingdon's reports of the City of London Truss Society for the years 1860 and 1861. It shows the ages of the individuals at the time of first discovering the hernia.

M. Malgaigne states that inguinal hernia is even more common in females than crural. L'Union méd., 1854, p. 154.

But it must be observed that this happens to be that period of life when parturition is most frequent, and when consequently the peritoneum and the tissues of the abdominal walls become much stretched by the development of the gravid uterus. Their power to resist the weight of the abdominal viscera becomes diminished; hence a cause of their protrusion.

To ascertain whether there was any relation between the development of hernia and parturition, Mr. Kingdon made the following table of 680 ruptured females, and found the proportion of mothers to be as follows:—

	Inguinal.	Femoral.
Infants and girls under 16 years of age . .	87	3
Single women . .	50	61
Mothers . . .	178	262
Married women who had not borne children .	19	20
Total . . .	334 +	346=680

And next, with a view to ascertain the influence of repeated pregnancies upon the development of hernia, he examined 442 women who had been mothers before discovering the hernia. Of these, 180 women were afflicted with inguinal, 262 with femoral; whch gives a majority of 82 in favor of femoral.

[In the Am. Journ. of the Med. Sciences for Jan., 1870, p. 267, there is quoted a case from Oettingen, of St. Petersburg, in which a woman æt. 32, fourteen days after her ninth confinement, sustained a crural rupture on the left side. Nine years after, strangulation having occurred, Dr. O. operated, and found the ovary and Fallopian tube contained in the sac. Reduction was difficult, but the woman quickly recovered.]

The influence of the first pregnancy is very remarkable. 442 women had been mothers before discovering the hernia:—

			Inguinal.	Femoral.
67	had borne	one child .	27	40
51	"	two children	26	25
53	"	three "	22	31
55	"	four "	23	32
40	"	five "	15	25
25	"	six "	8	17
34	"	seven "	15	19
30	"	eight "	13	17
25	"	nine "	7	18
19	"	ten "	10	9
16	"	eleven "	5	11
8	"	twelve "	4	4
4	"	thirteen "	2	2
10	"	fourteen "	2	8
3	"	fifteen "	—	3
1	"	eighteen "	1	—
1	"	nineteen "	—	1
442			180 +	262=442

[1] Report, 1860, pp. 10, 11.

By a preceding table the fact was demonstrated that crural hernia is most commonly developed between twenty years of age and forty. Now as we know that there is a much larger number of females alive between twenty and forty years of age than above forty, we might conclude that the number of cases of crural hernia is in proportion to the numbers of the population at any respective age. Under twenty years of age this is certainly not the fact, for the population at those early ages of life is of course the largest, whilst cases of crural hernia are exceedingly rare. The cause of the frequency of inguinal hernia during the early life of females has been before explained (p. 728).

It is highly interesting to compare the frequency of crural hernia at various ages with the numbers of the female population of London at the same periods of life; and in this inquiry we have made use of the census-table of 1851,[1] and Mr. Kingdon's statistics before alluded to. From those data the subjoined table is arranged:—

		Crural hernia.
Females under 20 years	493,260	38
" from 20 to 40 "	453,809	432
" " 40 upwards	308,609	278
	1,255,678	748

This shows the number of cases of crural hernia in a million females—

Under 20 years to be . .	77
Between 20 and 40 . . .	952
Above 40 . . .	901

Doubtless this calculation can only be considered as approximating to numerical accuracy; but it seems to demonstrate the truth of the general proposition, that females between the ages of twenty and forty years are most liable to the development of crural hernia under certain conditions. The cause of this liability is probably due to the natural condition before alluded to, coupled with its attendant circumstances, and the occupations of the class of persons which would apply to public charities; as well as, perhaps, to configuration, and some predisposing causes, or hereditary influences.

Morbid states of the crural hernia.—An irreducible crural epiplocele is very often seen; an enterocele in the same state is very rare. With a view to ascertain whether the strangulation of the bowel was in any degree influenced by the accompaniment or absence of omentum, we made an analysis of sixty-one cases of strangulated crural hernia, which came immediately under our own care for operation. The proportions were equal; there being thirty-one pure enteroceles, thirty entero-epiploceles.

A reducible crural epiplocele may at any time become inflamed, give rise to local pain, and increase in size. The local application of cold, and absolute rest, are the measures to be employed to prevent adhesion between the rupture and its sac. This condition of an omental rupture in the groin is sometimes mistaken for angioleucitis. But the history of the case, and the negative evidence derived from the absence of every primary cause of lymphatic irritation, should suffice to remove all difficulty in diagnosis.

Both Pott and Astley Cooper allude to circumstances which are of vital importance in the treatment of crural hernia, viz., the difficulty often experienced in the reduction of small recently-developed enteroceles, the rapidly extending injury of the bowel, and the severity of the constitutional symptoms which are excited by that condition. But these features have been more fully insisted upon by Mr. Bryant in a careful investigation of the cases admitted into Guy's Hospital.[1] Out of 142 cases of strangulated crural hernia, only 38 were reducible by the taxis. This, of course, is explicable by remembering that the majority of such cases are not sent to the hospital until the further use of the taxis is evidently unjustifiable. Ten of these cases were of recent development, that is, they were strangulated on their first recognized descent. This is an important feature in crural hernia, bearing especially on the results of treatment in these cases. It is cases of this kind which are so frequently overlooked by the medical attendant. He suspects that the symptoms exhibited by the patient are referable to a rupture, and he asks the question whether there is any tumor to be felt in the groin or elsewhere. Receiving a negative reply, he is content therewith. But that should not satisfy him. The surgeon should carefully examine the crural rings, and the other regions in which a hernial tumor may exist.

The mortality arising in cases of strangulated crural hernia of all kinds is very large; but in those where the bowel becomes strangulated on the first descent, the death-rate is the largest. The experience of a large number of these cases teaches that the bowel should be liberated as soon as possible, and, if the taxis be not successful when the patient is fully under the influence of chloroform, that the cutting operation should not be delayed a moment.

The youngest girl we have heard of

[1] Census, 1851, vol. i., p. 193, table ii.

[1] Guy's Hospital Reports, 1861.

suffering with strangulated crural hernia was between eight and nine years old.

Application of the taxis.—The patient should lie on the back, with the hip-joint more or less flexed. The surgeon, taking a position most convenient for the purpose, gently compresses the whole swelling, at first endeavors to diminish its size by pressing any serous effusion that may happen to be in the sac into the abdomen, and next to empty the bowel of its contents. Then recalling to mind the site of the crural ring, he presses the bowel backwards, inwards, and upwards.

The operation of liberating the strangulated bowel by incision.—The tissues to be divided to expose the sac are, the integuments, the superficial fascia, the fascia propria, and often a layer or covering of fat. The points to be particularly observed as guides for the safe and certain manipulation of the sac are, first, Poupart's ligament in front and above it; and, secondly, Gimbernat's ligament at the pubic border of its neck.

Slight variation in the line, direction, or figure of the incision through the integuments is admissible, according to the inclination of the operator; but for all practical purposes we prefer a linear incision of from two to three inches in length. It should cross over the pubic side of the neck of the tumor, and extend on to the abdomen about one inch above Poupart's ligament. Its form being slightly concave, the neck of the tumor is embraced by the concavity. The integuments and superficial fascia being divided, a well-defined, membranous sac is usually seen, and the operator should next display clearly Poupart's ligament above the tumor, and feel Gimbernat's ligament to the pubic side of its neck. This covering is the fascia propria. Next, he may pass a hernia bistoury, with great care, between the last-named ligament and neck of the tumor, outside the fascia propria, and, directing its sharp edge upwards, cut a few of the fibres of Gimbernat's ligament, or of those which unite the falciform process of the fascia lata to it (Hey's ligament), and thus enlarge the crural ring. This done, the reduction of the rupture may sometimes be effected by the application of gentle pressure upon the contents of the sac. This proceeding constitutes the minor operation. It is simple, safe, and well adapted to cases of recent enteroceles which have been strangulated a very few hours, and when there is reason to believe that the bowel has escaped injury by the taxis. Obviously, therefore, it is only justifiable in select cases.

Failing to reduce the contents of the sac, the fascia propria is next carefully divided upon a grooved director, and a layer of fat is very frequently exposed. Inexperienced operators, mistaking this fat for the omentum, are puzzled when they cannot find the bowel, or they mistake the peritoneal sac for intestine when that is seen upon clearing away the fat. The hernial sac being exposed, it should be traced upwards to the crural ring, and the fascia surrounding it in the crural canal divided; or the division of the structures forming the crural canal having been reserved for this special moment, must now be undertaken, as before described. But the hernia remains irreducible. With great care, and *secundum artem* (p. 700), the sac must now be incised. Through the first puncture a stream of serum usually flows. Empty the sac of the fluid by enlarging the opening sufficiently to reach its orifice. If nothing but omentum be seen, carefully raise it from below or gently unravel it, and towards the mouth of the sac, secreted behind that part of the omentum which has just escaped through its mouth, the bowel will be seen. Next, to enlarge the orifice of the sac, introduce the point of the finger between the protrusion and Gimbernat's ligament; but if that cannot be done, the hernia bistoury must be insinuated in front of the omentum, directing its cutting edge forwards and holding the blade parallel with the linea alba. Having then liberated the bowel from its constriction, it is easily returned into the abdominal cavity. It is not always necessary to cut the orifice of the sac, after having divided the tissues outside of it, as before described. Its tissues frequently yield before the gentle introduction of the finger.

Arrange the wound in such a manner that an opening exists at the lowermost angle for the escape of discharge, and flex the hip-joint by placing a pillow beneath the popliteal region for the limb to rest upon. Any further special detail for the treatment of the case is here unnecessary.

Mr. Kingdon has informed us that the extent to which Gimbernat's ligament is divided is a subject of grave importance as regards the future comfort of the patient. He states that Hey's ligament should rather be cut than Gimbernat's, and that when the latter is at all extensively divided, it is almost impossible to retain the hernia after the thickening, subsequent to the operation, has passed off. Certainly the most prodigious crural hernial tumors we have seen occurred in women upon whom an operation had been performed for strangulated bowel.

Arteries, cut during the progress of the operation, should be immediately twisted.

Wounds of the obturator artery.—This bloodvessel, when it passes to the obturator canal, after dividing from the internal epigastric or femoral, lies close to the

neck of the sac, and it has been occasionally cut at the same moment as its orifice. Before using the knife, it might be practicable to feel the pulsations of this artery with the tip of the finger. When cut, an attempt should be made to arrest the bleeding by twisting the ends of the wounded vessel. See Mr. Spence's case, p. 731.

Omental sacs are most commonly met with in cases of crural hernia. An account of them has already been given at p. 700.

Obturator hernia.—The obturator canal is situated at the upper and outer part of the obturator or thyroid foramen, and is bounded above by the horizontal ramus of the pubes, and in other parts by the obturator membrane or ligament and the obturator muscles, which are attached to its internal and external surfaces. The muscle within the pelvis is covered by the internal abdominal fascia, that outside by the obturator fascia. The obturator nerve, artery, and vein pass through the canal from the pelvis to the thigh. The course of the cutaneous filaments of this nerve should be especially noticed; for as its trunk is in close proximity to the hernial tumor, the pressure which the latter makes against it induces pain in those regions where the filaments of the nerves are distributed. In some cases this fact may prove a valuable aid in diagnosis, as the sequel will show.

This rare variety is described as hernia through the obturator canal, the foramen ovale, the thyroid or obturator foramen, and sub-pubic femoral. In the early part of the last century M. Garengeot[1] called the attention of surgeons to this kind of hernia, which after having escaped from the pelvis through the obturator canal, forms a swelling among the adductor muscles and in the pubic region of the thigh. The neck of the sac lies behind the horizontal ramus of the pubes, occupies the obturator canal, and makes its way sometimes between the uppermost fibres of the external obturator muscle, at other times above them. The fundus and body of the sac are covered by the fascia of that muscle. By the dissections of several cases, the obturator vessels and nerve are shown to be differently placed as regards the tumor. Vinson[2] states that he found the artery six times to the outer side of the sac, six times to the inner side, and three times behind it. The relative position of this artery to the sac probably bears some relation to its origin. In Mr. Stanley's case,[1] both artery and nerve were above the hernial sac; the former to its inner side, the latter towards its outer.

Both sexes are liable to the formation of this hernia, but a large majority of the cases on record occurred in females. The anatomical reasons for this are obvious.

There are cases on record in which this hernia had existed, and in which the viscus was strangulated without any local signs of a tumor. Mr. Hilton's case,[2] in which the entire calibre of the ileum was in the sac; and Mr. Tebay's,[3] in which only a part was found, are marked illustrations. In Mr. Obré's case,[4] "the eye detected a slight degree of fulness in Scarpa's triangle," and "a distinct hardness could be felt, slight in its extent." In the only instance we have seen, the hernia gave rise to a very distinct, well-defined tumor, deeply-seated among the adductor muscles, to the pubic side of the femoral vessels. In Mr. Stanley's case,[5] a crural epiplocele existed on the same side as the obturator entero-epiplocele. The latter was, however, extremely small, and produced "no swelling on the inside of the thigh." The hernia "was found with its peritoneal sac beneath the obturator externus muscle, between the muscle and the obturator fascia."

The foregoing observations illustrate the difficulties which attend the detection of protrusions through the obturator canal.

We have collected twenty-five of the most recently recorded cases of this variety of hernia, and the remarkable features they present are well worthy the attention of the reader. They may be divided into two classes: the first embraces a large majority, and consists of those cases in which the hernial tumor was not discovered during life; the second, those in which it was discovered by palpable examination, either immediately at the inner side of the thigh, or, as in one instance, only by an examination per vaginam.

In several of the cases of the first class, the tumor produced by the protrusion was so small that the sac, with its contents, being placed deeply among the adductor muscles and beneath the pectineus muscle, could not give rise to any local external swelling. In two cases the tumor was found between the obturator ligament and obturator externus muscle. The

[1] Mém. de l'Acad. roy. de Chir., t. i., part iii.

[2] Günther's Lehre v. d. blutigen Operationen, Abschnitt xv., § 146.

[1] Trans. of the Path. Society, vol. iii., p. 94.

[2] Med.-Chir. Trans., xxxi., p. 323.

[3] Med. Times and Gaz., vol. ii., p. 270, 1852.

[4] Med.-Chir. Trans., xxxiv., p. 233.

[5] Trans. of the Path. Society, vol. iii., p. 94.

contents of the sac in six cases consisted of only a portion of the calibre of the canal of the intestine. This had, however, become converted into a diverticulum, in some instances of considerable length. We meet with this condition of the hernia occasionally in other regions, but the cases are not common; and we may therefore conclude that, in proportion to the rarity of obturator hernia, this may be considered to be one of its remarkable features. In one case the Fallopian tube and ovary formed the contents of the sac; in another a portion of the urinary bladder.

[Zoja (Am. Journ. of the Med. Sci., July, 1877, from London Med. Record, May 15) records another case of this latter kind, which he thought to be unique. "Along the outer side of the neck of the hernia ran the obturator artery, derived in this instance from the epigastric; the protruded portion of bladder was not adherent to surrounding parts, contained a little urine, and was covered with peritoneum on its inner and lower posterior segment, which protruded like a hernial sac, while the front of the hernia was devoid of peritoneum."]

The hernial sac, which is never wanting, consisted always of a portion of the parietal peritoneum of the pelvis thrust through the canal, and tolerably firmly attached to the parts with which it was in contact. The sac was therefore slowly formed. On this account some of the patients had experienced, during the development of the hernia, repeated attacks of bowel derangement, evidenced by symptoms of obstruction, termed colic pains, uneasiness at the inner and upper part of the thigh, and even cramp or spasmodic pains in the muscles of the femoral region, and which extended down the leg.

In a large number of the cases, the acute pain in the course of the obturator nerve, described by the patient, was a marked feature of the case, and pressure over the site of the external aperture of the obturator canal gave rise to paroxysms of pain of great severity. It is due to the tact of Mr. Howship[1] to state that he seems to have been the first writer to dwell particularly upon this fact, which some years afterwards was strongly insisted upon by Romberg.[2] The only patient we have seen with this variety of hernia complained bitterly of feeling a sudden pain at the upper and inner part of the right thigh, which extended thence down the inside of the limb to the knee, front of the leg, foot, and great toe.

The cases of the second class are those in which the tumor was discovered during life, either in consequence of its bulk, or by a careful examination of the region in which it was developed.

Dr. Roeser[1] proposed that advantage should be taken of the rectal passage of the male, and the vaginal of the female, to institute a more searching examination of the obturator region within the pelvis; and by this means Dr. Lorinser, in 1857, discovered an obturator hernia.[2] Dr. Nuttall, of Leicester, in the same year, in a case in which not even fulness of the adductor fossa was perceptible, was induced, by the severity of the constitutional symptoms of strangulated bowel, and the pain caused by local pressure made directly upon the obturator region, to explore that part; and his judicious treatment was rewarded by the discovery of a very small hernial tumor, the contents of which were returned into the abdominal cavity by gentle pressure, without incision of the sac.[3] Before this Mr. Obré had succesfully operated upon a case of strangulated obturator hernia, in 1851, in which "the eye detected a slight degree of fulness in Scarpa's triangle, on the right side;" this triangle of the opposite limb being well-marked, with a hollow or depression passing down its centre, but which was lost on the affected side. Also, on pressing firmly "a little below the saphenous opening, a distinct hardness could be felt." Lastly, in the case successfully operated upon by Mr. B. B. Cooper, in 1853, the woman being very thin, there was both ocular and palpable evidence of an indisputable nature. At first sight the swelling in Scarpa's triangle seemed to be identical with that which might be produced by a protrusion through the crural canal; although it had not the appearance of being in close relation with Poupart's ligament, for it formed a somewhat globular fulness, rather than a circumscribed tumor. Then the point of the finger could be placed in the crural ring, which of course was conclusive evidence that the hernia had not escaped through it. Really, therefore, there were no practical difficulties to prevent the formation of a correct diagnostication in this case. We may here state that these observations are made from notes of the case taken personally at the bedside of the patient.

Complications.—But we must allude to a class of cases, of which there have been several instances, in which the existence of an obturator hernia was complicated with the development of other kinds, especially those in the inguino-femoral regions. In one case there was a reducible

[1] Howship's Practical Remarks on the Discrimination and Appearances of Surgical Disease, 1840, p. 323. Prep. in Mus. Coll. Surg., No. 1359.

[2] Romberg, in Dieffenbach's Operative Chirurgie, b. ii., p. 621, 8vo., Leipzig, 1848.

[1] Archiv. f. phys. Heilkunde, 1851, p. 142 et seq.

[2] Lehre v. blutigen Operationem, Abschnitt xv., § 147.

[3] British Medical Journal, p. 566, 1857.

crural hernia on either side: in three cases, a crural hernia on the same side as the obturator; in one case, on the opposite side; and in another case, an inguinal hernia on the same side as the obturator.

The treatment adopted in three of these cases was that which most surgeons would approve. The symptoms of strangulated intestine being clearly marked, an exploration was made of the hernial sacs, which were visible and tangible, in the expectation of finding a small knuckle of bowel retained within them. But nothing of the kind being found, the examination was not prosecuted further; although, in two of the cases, an obturator hernia, seated immediately beneath the site of the operation, was proved, by after-death examination, to have been the cause of death.

As a possible complication, we must here allude to the fact that in some of the cases, in the same individual, a sac was found to pass through both right and left obturator canals.

[Dr. John Chiene records (Edinb. Med. Journal, January, 1871) the finding in a dissecting-room subject of three obturator herniæ: one on the left side, with a portion of the ileum strangulated in it; and two on the right. One of the latter contained the outer half of the corresponding Fallopian tube.]

In fourteen of the cases the obturator hernia was not discovered until after death. In one case the symptoms indicated the existence of this variety of hernia, and the patient recovered without any interference on the part of the surgeon. In ten of the other cases the protrusion through the obturator canal was discovered during life; and the treatment adopted and its results we may briefly describe. In one case the protrusion was reduced after the application of the taxis by Dr. Roeser, of Bartenstein. This was in a female thirty years of age, rather corpulent, who had been frequently troubled with intestinal disturbance. By careful manipulation a small tumor was felt over the external aperture of the left obturator canal, upon which pressure caused great pain.[1] In another case Dr. Roeser was not so successful in the treatment. This was a male, fifty years old, who had been frequently troubled with pains in the abdomen, called colic. The case was rendered obscure by enlargement of the inguinal glands on the same side as the hernia; nevertheless Dr. Roeser diagnosticated the obturator rupture, and partially reduced it. The man, however, died, and after death a part only of the wall of the intestinal tube was found in the sac.[2] In one case the obturator hernia was discovered during life after the performance of gastrotomy.[1] Dr. Arntz saw a woman, sixty-two years old, when she had been suffering three weeks. He discovered and diagnosticated an obturator hernia, the integuments over which were inflamed and becoming gangrenous. He made an incision; the contents of the tumor escaped; and the patient died next day.[2] The accuracy of the diagnosis was verified after death.

Dr. Heiberg operated upon a woman, fifty years old, after distinctly feeling an elastic swelling in the left adductor region. Upon this tumor he cut down, opened the hernial sac, stretched the obturator canal with his finger, and returned the bowel. The patient, however, died.[3] Mr. Heath, of Newcastle, operated upon a woman seventy-five years old. The tumor, although small, was perceptible; the pain on pressure and down the limb very characteristic. The sac was opened, its orifice cut out, and a piece of dark-colored intestine returned. The aged patient survived the operation thirty-six hours, and the commencement of the attack about four days.[4] Dr. Nuttall, of Leicester, being called to a woman, aged seventy-five years, suffering with well-marked indications of strangulated intestine, but without any tumor in the usual site of hernial protrusions, was led, in consequence of pain being produced in that part when he pressed in one particular spot, to diagnosticate an obturator hernia, although there was not even "fulness" perceptible, over the site of the obturator region. He cut over this painful spot, found a small tumor, exposed the hernial sac, and reduced its contents by gentle pressure. This old woman survived thirteen days. After death the bowel which had been strangulated was found in process of repair. An obturator hernial sac was seen on both sides.[5]

We have now to describe the cases which have been cured by operation. The late Mr. Obré, of London, was the first surgeon to cure a case of strangulated obturator hernia. This was in 1851. In a woman, aged fifty-five years, tall and stout, he diagnosticated this hernia. He cut down upon the swelling, incised the sac and its orifice slightly, and returned a small piece of blue congested bowel.[6]

In 1853 I assisted Mr. Bransby Cooper in an operation he performed at Guy's Hospital on a woman forty-nine years old. She was exceedingly emaciated, had given birth to twelve children, and was affected with bronchitis. She was not aware of being ruptured. For sixty-two hours before coming to the hospital she had been suffering with strangulated intestine. Her illness began with a sudden

[1] Archiv. f. phys. Heilkunde, 1846, § 408.
[2] Ibid., 1851, § 142.

[1] Mr. Hilton, Med.-Chir. Trans., 1848, vol. xxxi., p. 323.
[2] Günther's Lehre v. d. blutigen Operationen, Abschnitt xv., § 148.
[3] Ibid.
[4] Lancet, 1857, vol. ii., p. 109.
[5] Brit. Med. Journal, 1857, p. 566.
[6] Med.-Chir. Trans., 1851, vol. xxxiv., p. 233.

pain at the upper and inner part of the right thigh, and extended from that spot along the the inside of the thigh, knee, front of leg, and to the great toe. Upon examination of the region below Gimbernat's ligament, a deeply-seated swelling was felt. Mr. Cooper made an incision over the tumor, divided the pectineus muscle, and reached the hernial sac. Gentle pressure was made upon it, and the contents passed readily into the abdomen. She slowly recovered, and the wound entirely healed; but before she left the hospital she was seized with acute bronchitis, which caused her death.

Dr. Lorinser, in 1857, discovered an obturator hernia by an examination per vaginam. The age of the patient is not stated. On the eleventh day after the commencement of the attack, he cut down upon the tumor, opened the sac, and found the contents in a state of gangrene. A fecal fistula was established, which subsequently closed, and the woman survived the operation eleven months.[1]

We believe that we have now given a brief but instructive summary of the cases on record from which useful practical lessons may be derived. There are more instances published, which have been discovered after death, and therefore simply attest the fact of the existence of the disease.

Mr. Kingdon believes he has met with five cases of obturator hernia in living persons. Two of them were in men; in both the femoral artery was in front of the swelling, and pushed forwards at each forced expiration. The men were past forty years of age, thin and gaunt. He does not recollect whether the femoral artery was pushed forward in the female, whose case he otherwise well remembers, but he distinctly recollects that he was able to feel the bony rim at the upper edge of the aperture through which he had returned the hernia. The woman was emaciated to the last degree of voluntary locomotion.

We propose next to select the most prominent facts from the whole number of cases, with an especial view to the diagnostication of those cases in which there may not be any palpable or ocular evidence of a rupture.

Diagnostication of an obturator hernia,—from its position. After passing along the obturator canal, it emerges upon the thigh below the horizontal ramus of the pubes, to the inner side of the capsule of the hip-joint; behind, and a little to the inner side of the femoral artery and vein; and to the outer side of the tendon of the adductor longus. The tumor formed by the protrusion is covered by the pectineus muscle. From crural hernia, therefore, it may be distinguished by observing the relative positions of the horizontal ramus of the pubes and of the femoral artery. Those structures occupy, in fact, a position between these two kinds of hernia. In obturator hernia they are in front of the tumor; in crural hernia they are behind it. In the former, then, they are easily felt; in the latter they cannot be without difficulty—not, perhaps, until the hernia be reduced. In those cases in which either a fulness, slight hardness, tumefaction, or swelling exists, coupled with well-marked indications of obstruction or strangulation in some part of the alimentary tube, the difficulty of diagnosis is not so very great; but how much embarrassment arises when those symptoms which betoken strangulated bowel exist, and a tumor is nowhere to be felt, let the numerous cases on record attest, in which the rupture has only been found after death.

Assuming, for the sake of illustration, that we have before us a patient suffering with well-marked constitutional indications of strangulated bowel, and that, after the most careful examination of all those apertures through which ruptures more commonly escape, we have failed to detect any palpable tumor to assist in explaining them, how are we to discover an obturator protrusion, or obtain sufficient evidence of the probable existence of one to justify an exploration of the obturator region by means of the scalpel? We reply, By pain during the development of the hernia; by pain at the commencement of the present attack; by pain of a peculiar character during the progress of the illness; by pain referred to the course of the cutaneous filaments of the obturator nerve and the plexus formed with it, and the internal cutaneous and its distributions; by pain excited by certain definite movements of the hip-joint; by pain induced by local pressure carefully applied; and by pain when an examination of the pelvic orifice of the obturator canal is made per vaginam [or per rectum].

We shall now describe these important indications with a little more precision. During the formation of the hernia, some of the patients had suffered at irregular intervals with constipation, nausea, and pain resembling colic in the pelvic region; and one woman related how upon repeated occasions she had suffered thus, and felt relieved directly after experiencing a sensation as if something slipped back into the abdomen at the lower part. In Mr. Hilton's case, some months before the fatal attack from hernia on the left side, the patient had suffered with symptoms of bowel-obstruction and pain referred to the right side. After death a right obturator hernial sac was found, "more distinct than on the left side, large enough to admit freely the forefinger."

One patient narrated, in a very striking

[1] Günther's Lehre v. d. blutigen Operationen, Abschnitt xv., § 147.

manner, how she had been suddenly seized with a violent pain at the inner and upper part of the thigh. Soon afterwards, nausea, followed by vomiting and all the other indications of strangulated bowel, existed.

In several of the cases there appears to have been something very characteristic in the nature of the pain. Admitting the difficulty of meeting with any two or more persons who would describe pain so closely resembling each other's sensations as to prove an infallible guide, yet that described during the progress of the illness seems to afford some clue in these cases. It is described as spasmodic contraction of the abdominal muscles, and not as pain within the abdomen. For the explanation of this phenomenon, we may refer to the association existing between the cutaneous filaments of the obturator nerve, which are irritated by the pressure of the tumor in the obturator canal, and the muscular filaments distributed in the abdominal muscles; for all are branches of the lumbar plexus.

The pain described by several patients, in both instances, when a hernial tumor was palpable, as well as when it was entirely concealed, could not have failed to attract the notice of the surgeon to the distribution of the cutaneous filaments of the obturator nerve, and the more internal of the internal cutaneous. In this fact we have a most valuable aid to the diagnosis of some abnormal pressure upon its trunk, as it traverses the obturator canal. Certain definite movements of the hip-joint may subserve very usefully in diagnostication, as, for example, when there may be some doubt on which side the protrusion exists, or when it chances to be so small as to be under the influence of the obturator muscles, when only in a violently contracted state. We may therefore employ the actions of these rotators of the femur outwards, to compress the tumor, and thus excite pain; and by comparing the influence of these muscles on both sides of the pelvis, valuable aid might be obtained. It has been demonstrated after death, that in some cases the protrusion passes between the fibres of the external obturator; and therefore we may suppose that they could readily compress the neck of the tumor. Want of space prevents further detail; we must therefore leave the adoption of this test, and the method of employing it, to the intelligence of the surgeon.

In several cases, the effect of local pressure over the external outlet of the obturator canal has been to cause acute pain, and even the detection of slight fulness or hardness when no other sign existed at the site of the protrusion. But even this examination should be made with great discrimination. A careful distinction must be made between pain caused by pressure on the obturator nerve and on a hernial protrusion; the muscles, especially the pectineus, must be relaxed; and a comparison of the results of the same amount of pressure on the two sides of the body in the same locality should be instituted with proper precautions. The femur should be supported by an assistant in a position of slight flexion, with rotation outwards, and between abduction and adduction.

The pelvic aperture of the obturator canal may be reached from the vagina in the female, and from the rectum in the male. In cases of difficulty and doubt, therefore, some assistance may be gained by taking advantage of the opportunities these passages afford for the necessary examination.

Accuracy in diagnosis being of paramount importance, we cannot conclude this part of the subject without alluding to the great advantage to be derived from carefully comparing the outline of Scarpa's triangle on both sides of the body; and of impressing upon those who may happen to have a case of suspected obturator hernia under examination, the practical value of seriously reflecting upon all the features of the case referable to nervous derangements, as aids to diagnosis in these most perplexing and difficult cases.

Treatment.— Should a hernia be detected, the application of pressure to the tumor may succeed in reducing it. The pressure should be directed in such a manner as to free the hernia from the ramus of the pubes, and pass it underneath it.

Failing to do this, or even with a well-grounded suspicion of hernia, the surgeon should explore the region below Poupart's ligament. The incision through the integuments should be either parallel with the trunk of the femoral artery, or with the fibres of the adductor longus muscle. It must be sufficiently far inside the artery to avoid the femoral vein. It may commence a little above Poupart's ligament, at a point midway between the spine of the pubes and the spot where the femoral artery passes over the ramus of that bone. The fascia covering the pectineus muscle being exposed, perhaps the hernial tumor may be felt; and if not, pain on local pressure may incite to a deeper prosecution of the search. This fascia and the pectineus muscle being divided in the line of the original incision, or its fibres being separated with the handle of the scalpel, some fat and the fascia of the obturator muscle are reached. As yet, however, the tumor has not been felt; nevertheless it may still be there, under cover of the fibres of the obturator muscle. These must be separated; for it is

not until the finger can be placed upon the outlet of the obturator canal that the search for the hernia should be abandoned as hopeless. Care must be taken to avoid cutting the filaments of the obturator nerve.

How far the surgeon would be justified in making an examination of the opposite side, after having failed to find the hernia on the one first explored, is a proposition we must leave to the judgment of those who may happen to be placed in such an unpleasant dilemma.

We conclude with this observation of Camper: "Forsan frequentiores sunt, quam quidem creditur; in ilio igitur ad omnis generis herniarum possibilitatem necessario attendendum est."

Perineal hernia.—The sac of this hernia is formed of the peritoneum, which in the male lies between the prostate gland and rectum, and in the female between the vagina and rectum. In both sexes, when the hernia fills the sac, there is a tumor in the perineum. This kind of hernia is most common in women, and usually consists of a portion of the alimentary canal, of the omentum, or of the urinary bladder.

The sac of a perineal hernia escapes between the anterior fibres of the levatores ani, and is covered by the internal abdominal fascia of that region of the pelvis.

The protrusion of the hernia may be prevented by using a T- shaped bandage.

Pudendal hernia.—Pudendal hernia forms a small elastic tumor in the labium pudendi. It lies in the posterior and inferior half of that organ, and forms a somewhat elongated projection at the side of the vagina. The neck of the sac is placed between the ascending ramus of the ischium on the outside, and the vagina on the inside.

This hernia may be developed at the early age of 22 years (Sir A. Cooper); and in this case it had existed some months.

The tumors in the labium, which may be confused with this hernia, are those formed by inguinal protrusions and collections of fluid. Of the last are cystic formations and hydrocele of the round ligament. These, however, are never reducible; they are not diminished by pressure, and they slowly increase in size from their first appearance.

From inguinal hernia it is distinguished by its position, shape, and relations. It has not passed through the external inguinal ring, but lies parallel with the axis of the vagina. It does not form a pyriform tumor in the labium, but a somewhat rounded mass. It lies by the side of the ramus of the ischium, and not over the body of the pubes.

From crural hernia it is distinguished by the neck of the tumor being placed entirely to the inside of the ramus of the ischium, and the muscles attached thereto.

A suitable bandage is required to support the protrusion.

Vaginal hernia.—This hernia is usually developed in women who have borne several children. It is only covered by the peritoneum, and by that portion of the walls of the vagina which protrudes. The orifice of the sac is usually large, and readily yields to pressure. Consequently it is easily reduced, and, with the exception of the discomfort and annoyance it causes, it is not attended with urgent symptoms. The rectum and urethra may, however, become so much compressed, that inconvenience, and sometimes suffering, may arise from this cause.

The protrusion requires to be replaced in the pelvis, and the necessary support to maintain it there is afforded by making use of a suitable bandage.

When the urinary bladder forms the rupture, which occasionally happens, great distress arises from a constant desire to micturate. The urine becomes ammoniacal, and the bladder so irritable, that a few drops of urine, constantly escaping, cause intolerable inconvenience. Treatment is, therefore, urgently required to improve the condition of this secretion, and to empty the bladder, whilst the rupture must be at the same time supported.

[See a paper by Dr. Fordyce Barker, of New York, in the Am. Journ. of Obstetrics, June, 1876.]

Ischiatic hernia.—This kind of hernia escapes through the ischiatic notch, and forms a tumor beneath the gluteus maximus muscle. The neck of the sac is either above or below the pyriformis muscle, but generally below it. The fundus, at first covered by the gluteus muscle, as it extends further out of the pelvis, escapes below the edge of that muscle, and lies under the integuments.

When the hernia is in the sac, it forms a tumor of variable size, soft, tense, yielding, reducible on pressure, and causing more or less pain. [See an interesting case reported to the Dublin Pathological Society by Dr. F. C. Crossle (Dublin Journal of Med. Science, Sept. 1873; quoted in the Am. Journ. of the Med. Sciences, Jan. 1874).]

Should the hernia become strangulated, and the operator be required to enlarge the mouth of the sac, Sir A. Cooper advises that the incision be carried directly forwards.

PART IV.

DISEASES OF THE GENITO-URINARY ORGANS.

DISEASES OF THE URINARY ORGANS.
CALCULUS.
LITHOTRITY.
DISEASES OF THE MALE GENITAL ORGANS.
GONORRHŒA.
SURGICAL DISEASES OF WOMEN.

PART IV.

DISEASES OF THE GENITO-URINARY ORGANS.

DISEASES OF THE URINARY ORGANS.

By Sir Henry Thompson.

Revised by Edward L. Keyes, A.M., M.D.

Under the term *urinary organs* will be here comprised the kidneys, ureter, bladder, prostate, and urethra.

It is extremely desirable, when dealing with any disease the symptoms of which are referred chiefly or entirely to some limited portion of the important system defined above as urinary organs, to possess an intelligent acquaintance, not merely with any part which may be especially liable to suffer morbid changes, but with the system itself as a whole. It is absolutely necessary to the formation of a correct diagnosis, to be familiar with the intimate relations which exist between each portion of that system, as well as with the various peculiarities which each is prone to exhibit when influenced by disease. Few things conduce more to error in estimating symptoms than a too exclusive specialism in the observation of disease. The study of stricture and of other forms of urethral obstruction, of vesical diseases, of calculous formations, and of those chronic changes in the secreting structure of the kidney which are conventionally assigned to the province of the physician, must be pursued together if the surgeon is properly to appreciate the import of any one of these affections. For example, suppose a surgeon to perform an important operation upon the bladder or urethra (and what operation there is not important?), who is unacquainted with, or is at least indifferent to, the chemical and microscopical characters of the patient's urine; will any one, who knows what those indications reveal, deny that elements most important to the formation of a correct diagnosis, and, therefore, to an appropriate therapeutical scheme, must be absent from the mind of the surgeon in relation to that case? It may be replied, that the necessary information can be obtained from the physician. Ought the surgeon to be dependent for an acquaintance with the facts required upon any other observer in such a case? Assuredly not; not only is the knowledge easy to attain, and convenient to possess, but it may be safely held that the medical man who views with equal intelligence the lesions, both functional and organic, which affect the kidneys, the bladder, and the urethra, will be, *cæteris paribus*, the safest and most successful adviser in the ailments of any one of those viscera. The relations which mutually subsist between each of the series, not only by contiguity, but by other and less obvious connections, are so numerous and constant, that a study of the whole can alone qualify the practitioner intelligently to treat disordered function in any part thereof. I do not hesitate to affirm, that no man can deal adequately and safely with cases of impaired urinary function, whose hand is not well trained to the use of the sound or catheter, whose eye is not familiar with urinary deposits in all their varieties of crystals, corpuscles, and renal casts, and who is not acquainted with their indications so far as these are known, as well as with the significance of those subjective phenomena which are found accompanying them. The exploring sound is quite as essential to the diagnosis of urinary disease as the stethoscope is to affections of the chest. He who is, conventionally speaking, a physician only, will (and does) constantly overlook calculus and stricture, to the great detriment of the patient; while the mere surgical handicraftsman will (and does) treat mechanically many a case which can only be injured by his manipulations. With these views, the careful study of all acute and chronic renal affections is recommended to the student who desires to qualify

himself specially for the practice of surgery.

The following is a table of those renal affections which necessarily come under the observation of the surgeon, in connection with the diseases of the bladder, prostate, and urethra, which so frequently demand his services. The limit assigned to the department of urinary disease in this work forbids more than the slightest glance at them; it appears, therefore, the more necessary to make these introductory remarks.

THE KIDNEYS:—

Malformations.
Injuries (vol. i., p. 898).

Inflammation (nephritis), *acute*	traumatic, idiopathic, and by extension. calculous. from obstruction in the passage below.
Inflammation (nephritis), *chronic*	calculous. from obstruction. diathetic.
Inflammation of pelvis of kidney (pyelitis) *acute and chronic*	from obstruction. calculous. scrofulous.

Calculous nephralgia.
Abscess of kidney and fistula.
Perinephritic abscess.
Tumors of the kidney.
Suppression of urine.
Hematuria.

Malformations.—There are few deviations from the normal conditions which can be regarded as malformations, and these are unimportant to the surgeon. It is only necessary therefore to enumerate the ordinary varieties. (1) There may be only one kidney, which is then usually larger than natural; it may lie in its usual place, or may in reality consist of the two organs joined in the median line, and occupy a position in front of the vertebral column. In the last-named condition the form is sometimes that of a horseshoe with its convexity downwards. (2) One kidney may occupy its ordinary situation, and a second may be movable, forming a tumor recognizable during life: or it may be fixed in an unusual situation, generally lower than natural, or within the pelvis. (3) The kidney may present an outline more or less lobulated, showing the persistence of a form existing in fœtal life, and natural in some of the lower animals.

Nephritis.—Acute and chronic.

Acute nephritis, of a severe form, is common in surgical practice. It exists also as a sequel to pre-existing chronic inflammation of the kidney, and in Bright's disease.

The causes of the first-named variety, with which almost exclusively we have to deal here, are as follows:—

Wounds, bruises, and strains; by extension from the bladder in cases of calculus, stricture, and cystitis, following operations or otherwise; retention of urine, causing distension of the ureter and fluid pressure on the kidney; renal calculus; entozoa; extension of inflammation from neighboring parts, as diseased vertebræ, etc.; diuretics in over doses; cantharides and turpentine; exposure to cold; and alcoholic drinks. It will be observed that many of these causes act almost exclusively on the male, and in connection with surgical affections. In the female, nephritis is more commonly associated with uterine diseases.

Symptoms.—The first is usually an attack of rigors; nausea, often vomiting, prone to be obstinate, generally soon succeed. Pains in the back and loins, dull and heavy, sometimes lancinating, increased by the upright position, by coughing and vomiting, even by respiration, and often extending along the ureter. Occasionally there are aching or numbness in the thigh of the side affected, and tenderness on pressure in the renal region, sometimes considerable. Micturition is frequent; the urine is mostly high-colored and scanty; neutral or alkaline; often mingled with blood, and then becoming albuminous, not otherwise; later in the disease it may be purulent. Under the microscope renal casts may be found containing pus and blood-corpuscles. Sometimes total suppression occurs. General signs of fever are present, as heat of skin, dry furred tongue, headache, thirst, quick and hard pulse. Anasarca often appears also, in cases suddenly occurring from exposure to cold; not commonly in cases of extension from the bladder.

In the latter instances, suppuration in the substance of the kidney is to be dreaded; the symptoms are then more intense, there is great depression of the vital powers, and fatal coma often occurs by uræmic poisoning. If pyelitis accompanies or supervenes on nephritis, there is also generally pain and retraction of the testicle on the affected side.

As it is impossible to include in this work a history of all the renal and allied affections with which the surgeon should be familiar, a few remarks will follow here on the differential diagnosis of nephritis, so as to illustrate the leading characters of those other diseases which might be confounded with it.

The *diagnosis* is not generally difficult, although in a few instances it may be obscure. If a patient, who has suffered long from urethral or vesical disease, or who has recently undergone an operation for stone or stricture, suddenly shows signs of an acute febrile invasion, with vomiting, pain and tenderness in the renal region, scanty urine, or urine mixed with blood, there can be little doubt of the presence of acute nephritis. When there is no history of previous urinary complaints, an attack of primary acute nephritis may sometimes be confounded with the following affections: calculous nephralgia; pyelitis, simple and calculous; perinephritis; perinephritic abscess; spinal disease, or abscess of the psoas or adjacent parts; lumbago; renal neuralgia and hysteria; inflammation of the bladder; vesical calculus.

1. *Calculous nephralgia;* by which is intended the pain and systemic disturbance occasioned by the descent of a calculus from the kidney to the bladder, and which sometimes resembles very closely acute nephritis. Indeed, excepting only the severe febrile symptoms, all those of nephritis are present. There is acute pain, generally limited to one side, and shooting along the loins to the sacrum, with retracted testicle; but the invasion is more sudden, and the pain more acute, than in nephritis. There may be vomiting, frequent micturition, and bloody urine; but the constitutional disturbance, although it may sometimes be present in moderate degree, certainly falls short of the fever which always accompanies the inflammatory affection. If the calculus obstructs the pelvis or ureter for any length of time, symptoms of calculous pyelitis may arise. And lastly, all the phenomena may suddenly disappear, which confirms the diagnosis of calculus.

2. *Acute calculous pyelitis* may be distinguished by the following characters: the pain in the back is excessively severe and lancinating, much more so than in nephritis; shooting pains are felt in the groin and inner part of the thigh, radiating to the testicle, which is generally strongly retracted. When the pyelitis is unaccompanied by renal affection, the urine is often acid; and although it may be scanty at first, is subsequently voided in natural quantity. It may have much pus and epithelium mixed with it, and sometimes blood; if so, these matters are found in intimate admixture with the urine. The course of the complaint is less rapid than that of nephritis, and there are frequently considerable intervals of freedom from pain.

3. *Perinephritis; caries of spine.*—Inflammation of the tissue surrounding the kidney does not generally make its appearance with an acute attack. The subsequent formation of matter, if it takes place, is accompanied by febrile symptoms; but the gradually increasing swelling, in its later stages presenting fluctuation, while at the same time the urine is healthy, is significant of simple perinephritic abscess, provided the special signs of spinal disease are absent. If, on the contrary, there has been marked tenderness on pressure or percussion at one spot over the vertebral column, and, *à fortiori*, if there exists angular curvature, if there has been any interference with the functions, either of sensation or of motion, the spine is obviously the seat of disease. When abscess of the psoas exists independently of the signs of spinal disease, there will generally be noted some disturbance in the nerve-function of the corresponding thigh; and at the same time the motions of the hip-joint will be impaired by the inability to act, from the loss of power in the psoas muscle. Pain on pressure also is more marked in front than behind, the reverse occurring in perinephritis, and sometimes in nephritis.

4. *Rheumatic affection* of the dorsal muscles, or lumbago, is usually productive of great pain, on any effort being made which necessitates the slightest movement of these muscles, much more so than in nephritis; pains also often exist elsewhere, but vomiting and other constitutional signs are absent. Again, the urine is neither suppressed nor materially altered in character; it may be more than usually acid, but it is not alkaline.

5. *Renal neuralgia* is met with, but chiefly in women. Very severe pains are complained of by individuals of nervous and hysterical temperaments, which it does not require very acute observation to separate from nephritis. The condition of the urine, mostly pale and abundant, the absence of constitutional symptoms, and the existence of mental excitement, will be sufficient to mark these cases.

6. *Acute cystitis* is sometimes attended with phenomena which seem to indicate that the kidney is the seat of disease. There may be present great pain in the renal regions, and febrile symptoms of severe character; but also in the pubic and perineal regions; and there are suprapubic tenderness and suffering in passing water, while the urine, which is usually acid, exhibits abundance of small flakes of exudation-matter floating throughout,

and is clouded, yet has only traces of albumen and no blood mixed with it. It may contain pus, and be alkaline; but this is generally as the acute subsides into the chronic form of disease. In later stages of severe cystitis the urine becomes bloody.

7. *Calculus of the bladder* is sometimes attended with an aggravation of symptoms which may be mistaken for acute nephritis. All the local and much of the constitutional disturbance of the latter complaint may be produced, as their rapid subsidence seems to indicate, from mere temporary irritation of the kidney, occasioned by the presence of calculus in the bladder. An examination of the previous history and symptoms, of the urine itself, and the speedy relief which follows simple remedial means, will indicate the real cause, respecting which the sound subsequently employed at the proper time will enable us to clear up any doubts which may still exist.

Treatment of acute nephritis.—It is of importance at the outset to insure free action of the liver and bowels, which are often very obstinate. In addition to active purgatives, enemata are recommended; but distension of the colon with irritating fluids is undesirable, and emollient injections alone are admissible; thus, turpentine should be avoided, lest absorption should irritate the kidney. Perfect rest in bed, and low diet, are to be enjoined. Local bleeding by leeches or by cupping is very serviceable; by the latter mode ten or twelve ounces may be taken, and the bleeding may be repeated with advantage if the patient is hale and the attack severe; otherwise, it should be followed by dry cupping, daily or on alternate days. The utility of antimony and salines (generally more or less diuretic) is questionable, and the repeated administration of diuretics is contraindicated; the moderate use of simple diluents, water, linseed-tea, barley-water, or milk-and-water, is preferable. Free action of the skin should be promoted by hot baths or large hot fomentations. For the vomiting, when obstinate and distressing, hydrocyanic acid and creasote fail, though sometimes successful in mild cases; but counter-irritation to the loins and pit of the stomach affords better results; a constant supply of ice in the mouth also helps to allay it. When head-symptoms appear, the most efficient remedies are purgation and renewed counter-irritation over the renal region; similar applications should be made to the temples and to the nape of the neck, with hot bottles and sinapisms to the feet and legs. In applying counter-irritation, cantharides should not be employed, on account of its known irritant action on the kidney, in some cases even by endermic application; the desired result may be attained equally well by chloroform, ammonia, mustard, or more slowly by nitrate of silver. If either of the two former are selected, dilute with equal parts of spirit; soak a piece of lint of the size desired, and lay on the surface, covering instantly with oiled silk, and making gentle pressure; in a few minutes the full effect will be seen. In later stages of the complaint, internal stimuli and support may be necessary.

Where acute nephritis first shows itself, as is often the case in surgical practice, by extension from the urethra or bladder in a debilitated subject, the general principles enumerated above must guide the treatment, but actual depletion is rarely permissible. All unnecessary irritation of the urinary apparatus must be avoided, and no catheters be passed, if they have been necessary before, unless absolutely demanded by the exigencies of the case, and then with the utmost care and gentleness. If following lithotrity, all mechanical interference must be suspended, and catheterism used only to relieve an obvious retention. If suppuration take place in the kidney, or the urine be suppressed, little can be hoped for from treatment; active counter-irritation of the renal region and internal stimuli must be perseveringly employed while any hope exists.

Treatment of the attack of calculous nephralgia.—The hot bath; antispasmodics and opium liberally administered; cupping to the renal region, and hot cataplasms afterwards; mild diuretics, particularly the decoction of the couch grass or triticum repens; abundance of diluent drinks. Sometimes the occasional inhalation of chloroform, to relax the muscles for a period of ten to twenty minutes, has has been of service. [Morphia subcutaneously, enough to relax general muscular spasm and quiet pain, is of great value, especially as it may be combined with copious draughts of Bethesda or Poland water, or even of light beer. Manipulations and frictions of the parts about the kidney have been found of value, as has also the local application, during the paroxysms of pain, of the induced electrical current.]

Treatment of chronic pyelitis.—If occurring from obstruction in the urethra, the most efficient treatment consists in overcoming it, and enabling the urine to pass freely, so as to relieve the dilated and diseased pelvis of the kidney from distension and pressure. At the same time, the purulent discharge is sometimes diminished by full doses of buchu, and small doses of cubebs and the balsams; sometimes by mineral acids. Abundant nutriment is generally necessary. If the com-

plaint depends on calculus in the kidney, and an examination of the urine or the history has indicated pretty clearly the nature of the formation, appropriate remedies can be taken with the view of dissolving it, or at least of hindering its increase. Such are alkaline salts, as the citrate of potash in uric acid calculi, and acids, mineral or benzoic, for those which are phosphatic. All sources of local irritation must as much as possible be avoided, as sudden or violent movements of the body, and irregular habits of all kinds. Wherever the signs of general malassimilation are present, especially those of the tuberculous diathesis, the appropriate constitutional treatment must be enjoined. Scrofulous pyelitis is, however, rare.

Abscesses may be formed under these circumstances; also as the sequel of nephritis; they should not be opened until the tumor points and the diagnosis is perfectly clear. Often they are perinephritic, although originated by disease within the kidney itself; occasionally a calculus may be removed through the opening made. If not opened sufficiently early, these abscesses may make their way internally, or along the sheaths of muscles, and open in the groin or elsewhere. They may heal soundly, or give rise to renal fistula.

[If there are reasonable grounds upon which to base an opinion of the existence of a collection of pus in the pelvis of the kidney, or in the secreting portion of the organ, which cannot easily void itself, it is certainly sound surgery to explore such a suspected kidney with the aspirator, and if pus be detected, to perform nephrotomy, cutting down through the loin, and liberating the morbid accumulation. In one such case I operated in this manner in connection with Dr. Van Buren, letting out a pint of pus with the happiest result, although the perinephritic tissues were normal, and the kidney nowhere adherent.]

It is necessary to bear in mind that other tumors in the renal region may be confounded with abscess, such as cystic disease of the kidney; simple fluid distension of the pelvis; accumulation of blood in the same situation; encephaloid and tubercular deposits, and hydatid cysts adjacent to the kidney; besides abscesses, which are the effects of spinal caries. Among these, ordinary cystic disease affords no very obvious signs; the character of the urine may be unaffected; if the cyst is large, dulness on percussion is present. Distension of the pelvis with fluid may be due to retained urine, or merely serous fluid, and may in very rare cases afford the sense of fluctuation externally. If there is a partial communication with the ureter, the amount of water passed will differ greatly on different days. Cancer of the kidney is encephaloid in six cases out of seven; the pain is severe, the growth rapid, the tumor extremely large and abdominal; hæmaturia is present, and the diathesis is generally marked. Tubercle in the kidney rarely produces a tumor appreciable during life, and its symptoms point much more to the bladder than to the organ affected; tubercle in the lungs, and elsewhere, usually coexist. Tumors containing blood are almost invariably recognized as originating from direct violence, or from a strain in violent exercise. Tumors containing acephalocysts are very rare; they are usually in connection with the pelvis of the kidney, and may exist for a very long period without rupture, subsequent to which hooklets, etc., are found in the urine. In rare instances both these and the tumor produced by great distension of the pelvis of the kidney have been successfully punctured.

Chronic nephritis is not always a well-marked disease, except as a sequel of the acute attack, not including under the term that constitutional state of which the most marked sign is the admixture of albumen in the urine, and which is ordinarily known as Bright's disease. Here the kidney is, strictly speaking, perhaps secondarily affected; but the fact of its degeneration may be always noted in advanced stages. It is of the utmost importance that the surgeon should be familiar with its phenomena, as, in dealing with diseases affecting the bladder or urethra, the presence of Bright's disease is a circumstance of grave import, which may greatly influence the treatment required by the other affection; nevertheless, its purely medical character as a blood disease must exclude its consideration here.

The remedial means for simple chronic nephritis consist in local stimulating applications to the renal region, avoiding specific renal irritants, before specified, combined with the constitutional treatment of chronic inflammation.

Renal calculi.—See the essay on CALCULUS.)

Hematuria signifies simply the presence in the urine of blood, which may exist in any quantity, from an amount discoverable only by the microscope, up to that in which it constitutes the major proportion of the fluid passed by the urethra. It is a symptom merely of disease in some part of the urinary organs. When blood is present in small proportion, and has been in contact with the urine for a considerable time, the latter presents a peculiar brownish color, characteristic to the prac-

tised eye, and commonly known as the "smoky tint." If in large quantity, under similar circumstances, the mixture has the appearance of thick or muddy coffee. The source of the blood in hematuria may be any one or more of the following parts: the kidney, the pelvis of the kidney, the ureter, bladder, prostate, or urethra.

Hematuria occurs in acute and chronic diseases of the kidney; from injury, as by blows, strains, etc.; from calculus in any part of the urinary tract; from violent diuretics, as turpentine or cantharides; in cystitis sometimes; in prostatic disease; in malignant disease of any part of the urinary organs; in villous tumors of the bladder; in the hemorrhagic diathesis; and in certain states of the blood, as in fever, purpura, and allied conditions; in stricture of the urethra; from chordee; from the local application of mechanical and chemical agents.

It is always important to determine its source; the following hints will assist in forming a correct diagnosis:—

Renal hemorrhage, not being traumatic, is usually preceded or accompanied by some signs of kidney disease; which is most frequently acute desquamative nephritis, and renal casts are usually found in the urinary deposit; the blood is always intimately mixed with the urine, which shows the smoky tint. Further, it may be said, as a general rule, that such urine passed without pain, or any other local symptom whatever, is more likely to derive its blood from the kidney than elsewhere. Hematuria from a calculus impacted in the pelvis or ureter is associated with the history and signs of the occurrence (see Calculous Nephralgia). Hematuria caused by a blow on the back is mostly from the pelvis or ureter. Malignant disease occasioning hematuria presents sooner or later some physical characters associated with the organ which is affected.

Blood derived from the neck of the bladder or prostate generally remains within the cavity, and if in large quantity forms a clot there, perhaps distending the viscus; or the urine has the color of porter, and a darker sanies comes away at the close of micturition. When altogether from the prostate, a portion usually issues unmixed with urine by the urethra. In malignant disease of the bladder or prostate, disintegrated shreds of tissue come away with the urine, and occasionally cancer-cells (so called), and the blood is apt to appear suddenly in large quantity. In villous tumor, characteristic shreds of that growth are sometimes detached; in both this and the preceding case the bleeding is large, and its occurrence irregular, but it is much less so in the latter case than in the former. With villous growth the blood is more intimately mixed with the urine, which is constantly more or less stained. The appearance of a drop or two of almost unmixed blood at the end of passing water may be caused by either calculous or chronic prostatitis; the history, the distinctive symptoms, and the sound will determine which.

When the hematuria is due to urethral sources, and these are numerous (such as injury to the penis from blows or lacerations, and in falls, with or without fracture of the pelvic bones; chordee; occasionally from rupture in sexual intercourse; from surgical instruments; in some forms of stricture, from severe efforts to pass water; impacted calculus; sometimes in severe gonorrhœa; phagedænic ulceration; and malignant disease), it will be found that although blood is often mingled with the urine, it generally issues from the urethra in a pure state, unmixed with the contents of the bladder, and at other times than during the act of micturition; long and slender clots, also, forming casts of the urethral canal, are often voided.

It is necessary to take care that the color of the secretion in the alleged hematuria is due to blood. Bile, rhubarb, and other coloring matters, also mere concentration, will produce a dark and reddish tinge. The disappearance of the color by heat, and the precipitate of albumen, indicate blood; but the microscope determines it without fail. For minute quantities, often a matter of extreme importance to identify, in connection with calculus in its early stage and in other circumstances, the detection of the blood-corpuscle by means of the microscope is the only certain method.

Treatment.—Renal hemorrhage must be treated, when due to calculus, malignant disease, and violence, by absolute rest, in the recumbent position, and by internal styptics, such as gallic and sulphuric acid, matico, and acetate of lead, combined with opium; when produced by purpura and Bright's disease, by iron and other appropriate remedies. Hemorrhage of the bladder may demand similar general management, if it is considerable; but local means are here more powerful. Thus ice should be applied to the perineum and hypogastrium, the patient maintaining perfect quiet in bed; a little ice-cold water, or iced infusion of matico, may also be injected into the rectum, or small pieces of ice may be placed in the bowel. It is recommended that a catheter should be passed into the bladder, the clot broken up, and that efforts to remove it should be made by applying an exhausted gum-bottle, or syringe, to the

instrument; but such interference is undesirable, unless absolutely necessary from retention of urine. The breaking up or otherwise disturbing a clot is liable to open orifices of vessels closed by recently deposited fibrin, and to provide a fresh cavity into which more blood may be poured. Besides, there is no ground for regarding the clot as a great evil, which must be got rid of at all hazards. The solvent power of urine, possessing a temperature of about 100° Fahr., is very great, and is probably the most efficient and the safest agent in effecting the purpose.

It does happen, though very rarely indeed, that mechanical means must be adopted to remove firmly adhering coagula, and the bladder has even been opened above the pubes for that purpose; in almost all cases it is wiser to allow nature to do the work, than to be officious in rendering assistance. The distress occasioned to the patient by the urgent wants to micturate is greatly relieved by the use of opium either by mouth or rectum. When it is necessary, however, to use an instrument, as when the patient is incapable of passing any urine by his own efforts, a full-sized catheter should be passed, and a syringe, or stomach-pump, or, better still, Clover's exhausting apparatus for lithotrity, adapted to it, by means of which a considerable portion of clot may be gently withdrawn. It should not be forgotten that Sir B. Brodie records a case in which, all other remedies having failed, a dose of Ruspini's styptic, administered internally two or three times in the course of twelve hours, was followed by complete cessation of the bleeding.

Suppression of urine.—This term applies only to a condition in which the kidney fails to perform its function of secreting urine. The bladder is empty, or having been emptied, continues so, since it receives no more by the ureters. Meantime the materials of the excretion accumulate in the blood, and the vital powers become oppressed; a comatose state ensues, and finally death, unless the eliminating function of the kidney is resumed, and the urine again excreted. This function is sometimes totally, but only temporarily, suspended; more commonly it is after long impairment by chronic disease gradually extinguished. Advanced chronic disease existing, any sudden shock from operation, however slight, from acute attack, etc., may rapidly induce fatal suppression. The two conditions of suppression and retention have been much confounded. None, however, can be more distinct: in the former the bladder is empty, in the latter it is unnaturally full; in the former no urine is secreted, in the latter the secretion goes on as usual, but some obstacle opposes its removal from the bladder. The symptoms are these: the patient usually complains of languor, fever, vomiting, more or less pain in the back and loins; he is unable to pass urine, or only a very small quantity; he soon becomes drowsy, perhaps delirious, then comatose, and dies in from two to four days if suppression remains complete. There may be anasarca, but often there is none. Catheterism shows that the bladder is empty.

Treatment.—Local cupping; but if the patient is in low condition, without abstraction of blood; hot fomentations and counter-irritation to the renal region. The hot-air bath and free purgation, to aid in eliminating excreta from the system. I have seen, in one case only, recovery after forty-eight hours of complete suppression; I have seen it not unfrequently after twenty hours. In the later stage of chronic renal disease, little is to be hoped for from treatment.

The Ureters present very little occasion for notice.

Malformations.—The most common deviation from the natural condition is that of increase in number; two or three ureters may issue from one kidney, and may be continued down to the bladder, but much more frequently unite to form one channel. Sometimes one ureter only exists; sometimes the ureter is incomplete, and forms a canal with a closed extremity. None of these conditions possess interest from a surgical point of view. The ureter is liable to inflammation, which extends by it from the bladder to the kidney. It may be the subject either of stricture or of obliteration, which conditions are generally produced by injury caused by the passage or impaction of calculi; occasionally from pressure by a tumor; rarely from external injury. It is often greatly dilated, when obstruction exists at the neck of the bladder, or in the urethra, from hydraulic pressure slowly acting upon it; and sometimes to such an extent as to become a supplementary reservoir to the bladder. It has even been seen prolapsed into the bladder, forming a tumor there. It may be the subject of malignant and tubercular disease by extension downwards from the kidney, or upwards from the bladder. A calculus is sometimes arrested in its passage through the ureter, occasioning great agony (see Calculous Nephralgia).

The Bladder.

Malformations.—These are happily not very common, since, of whatever kind,

they are the source of great discomfort, and even of misery, to the subjects of them.

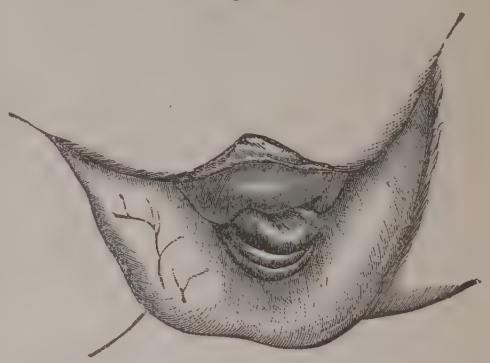
1. Absence of the bladder. The organ is sometimes, although very rarely, absent. (*a*) The ureters have been seen to communicate directly with the urethra; in one case these ducts were somewhat dilated before entering it, in another this condition was not noticed. This abnormity has been only observed in the male sex. (*b*) Less rarely the ureters have been found entering the rectum, and discharging the renal excretion entirely by that channel. These instances have chiefly, although not entirely, been discovered in the male. (*c*) A few instances are on record in which the ureters opened directly into the vagina.

2. Two or more bladders, it is said, may coexist in the same subject as a congenital malformation. Two cases only are recorded which have any title to be so regarded: one of these occurred in a man in whom the ureter of each side appeared to have its own distinct bladder, the two reservoirs being closely united to each other at their adjacent surfaces (Blasius); the other in a woman who is reported to have had five bladders, five kidneys, and six ureters (Molinetti). I am satisfied that other cases reported as belonging to this category, including one recently described with great detail, were evidently examples of sacculation resulting from long-standing disease. Sometimes the organ appears to be partially divided by a septum, or to be formed of two more or less symmetrical lobes: but although these cases have been often regarded as instances of malformation, they are in reality also the effects of disease.

3. Extroversion of the bladder. This is the least rare of all the vices of conformation to which the organ is subject. In these cases the anterior wall of the bladder is wanting, while frequently, but not invariably, the pubic symphysis is absent also. The posterior wall and base of the organ are then pushed forward by the abdominal viscera, and form a red and vascular flattened prominence, covered by mucous membrane, in the situation of the pubes. The extroverted portion is in the adult usually about the size of the palm of the hand; the orifices of the ureters may be seen just below the centre, and from beneath the lower margin a short imperfect penis projects, which is flattened, as if cleft in the median line, into the urethra. At the root of the penis a rudimentary prostatic structure exists, the ducts of which can be seen opening into the angle between the bladder and pubes. There is usually more or less hernia of the bowels on either side and beneath the extroverted bladder, into a pouch-like fold of integument, which is covered with hair, represents the scrotum and contains the testes. The mucous membrane is very sensitive, readily bleeds when touched, and from the projecting orifices of the ureters urine is almost continually distilling over its surface. This condition produces much excoriation of the skin on the parts beneath, besides infecting the patient with a continual urinous odor. The malformation thus described affects both sexes, but appears to be more common in the male. Of eight cases which I have personally examined, two only were in the female. From the condition thus described, there are some slight peculiarities of detail in different cases; but most conform very much to the characters given. The defect is of a less serious character, sexually considered, in the female, as the generative function does not necessarily remain in abeyance; the male, however, is, from the condition of the penis, wholly incapacitated for its exercise.

Treatment of malformations.—The results of extroversion may be palliated by well-adapted mechanical means; an artificial reservoir may be employed, but great nicety of fit and capability for adjustment in various positions of the body must be attained by the mechanician. Little formerly could be said, from the results of past experience, in favor of the employment of operative measures to remedy these defects. Dieffenbach and Langenbeck in Germany, Richard and Nélaton in Paris, have made attempts to remedy deficiencies of this kind, the cases of the latter being however rather exam-

Fig. 429.



Extroversion of the bladder, drawn from life. The upper and largest prominence is the mucous membrane of the bladder, with an aspect like red velvet; the mouths of the ureters are hidden beneath its lower margin. Below that is the short and wide penis; the exposed urethra opened out in its whole course, on the upper aspect. The large pendulous bag below all contains the testicles and some intestine.

ples of complete epispadias, than of extroversion of the bladder. Pancoast of Philadelphia, in 1858, was also partially successful in an instance of the last-named condition. In our own country Mr. Simon, of St. Thomas's Hospital, has attempted, in a male case, to turn back the orifices of the ureters into the rectum; but with results which could scarcely be considered successful, although approximating thereto. Other cases of operation have been fatal.[1] In the female the nature of the operation required is less formidable, inasmuch as the indication is rather simply to cover the bladder than to alter the course of the ureters. Dr. Daniel Ayres, of Brooklyn, U. S., appears to have succeeded in covering the extroverted bladder of a young woman with integuments borrowed from the neighboring parts of the abdomen.[2] The operation consisted in bringing down a flap of skin from the part above, and turning it down over the bladder below, so that the cutaneous surface was in contact with the mucous membrane, and in bringing up the integuments, previously raised by dissection, from each side of the vulva towards the middle line to meet the flap described. The result obtained was a covering to the bladder, and a small opening for the exit of the urine, which admitted with ease the application of an efficient apparatus to retain it. But Mr. Holmes has recently succeeded in covering the part by lateral flaps, in a young male child. Incontinence exists of course as before; but an instrument may now be easily contrived to catch the urine, and the patient no longer suffers pain or abrasion by friction. I have examined this patient, and consider the improvement beyond question. (See Lancet, 1863, vol. i., p. 714.)

Since this period, Mr. Holmes has developed and improved his method, having several times repeated the operation. By covering in the exposed mucous surface and contriving to leave a small opening only at the lower part for the escape of urine, he has saved the pain of contact between the sensitive surface and the patient's clothes, and insured the removal of urine without excoriating the skin: very important objects, and well repaying, when attained, the somewhat tedious and repeated steps of a plastic operation.

He has also designed a procedure for forming artificially a kind of cloaca, common to the ends of the ureters and the rectum, by inducing sloughing of the tissues composing the trigone of the bladder

[Fig. 430.

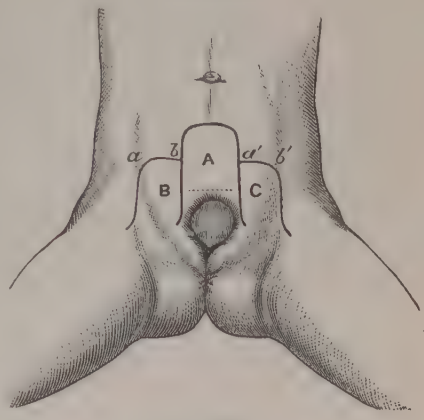


Fig. 431.

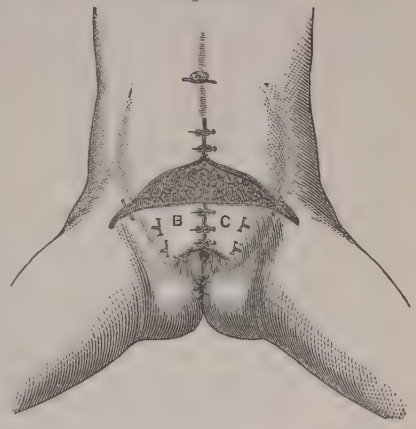
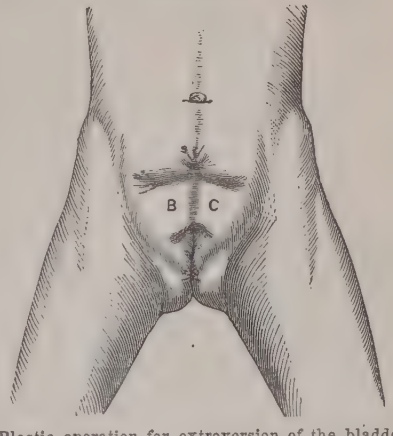


Fig. 432.



Plastic operation for extroversion of the bladder. (From a patient in the Children's Hospital.—Ashhurst.)]

[1 See a very interesting case recorded by Mr. Simon in St. Bartholomew's Hospital Reports, vol. xv.]

2 Congenital Exstrophy of the Urinary Bladder. By Daniel Ayres, M.D. New York, 1859. Another successful case is reported by Mr. E. Barker, of Melbourne, in the Medico-Chirurgical Transactions, vol. liii., p. 187.

and the anterior wall of the bowel. For details in relation to both these methods, it will be necessary to consult the author's work.[1]

Mr. John Wood, of King's College Hospital, has also practically studied the subject of plastic operations for this deformity, and with considerable success. He has operated (up to the summer of 1868) on eight cases, and an interesting account of his modes of proceeding, and of the results obtained, is to be found in the Medical and Chirurgical Transactions for 1869.[2]

[Mr. Wood's plan is shown in the annexed cuts, taken from Prof. Ashhurst's Principles and Practice of Surgery. Fig. 430 represents the plan of the operation, by three flaps, of which the upper, A, is turned down, while the other two, B and C, are brought toward the median line so that their edges, *a b*, *a' b'*, come together.

Fig. 431 exhibits the completed operation, and fig. 432 the result, from a patient of Prof. Ashhurst's at the Children's Hospital in Philadelphia. Methods have been described by Pancoast, Ayres, Maury, Barker, Bigelow and others, varying in different details from the above, which however affords the best prospect of success.]

Injuries of the bladder.—(See vol. i., p. 821 et seq.)

Diseases of the bladder.—In entering upon a consideration of the numerous affections which range themselves under this heading, I shall adopt the following classification for the sake of perspicuity. We shall study first those diseases which present local anatomical characters, establishing the nature and extent of the lesion which has given rise to the symptoms observed; and, secondly, those more obscure diseases in which similar symptoms occur, but which do not necessarily or generally involve any organic structural changes.

I. *Diseases which involve organic structural changes, the existence of which is generally recognized during life, and is always appreciable after death.*

These may be arranged as follows:—

- *Inflammation (cystitis):*
  - Acute . . .
    - due to injuries and operations.
    - " presence of foreign bodies (calculi, etc.).
    - " prolonged retention of urine.
    - " extension from urethra or kidney, or supervening on chronic cystitis.
    - " external cold.
    - " chemical irritants taken by the mouth.
    - " chemical irritants injected into the bladder.
  - Chronic (*a* with, and *b* without, catarrh):
    - as a sequel of acute.
    - as the result of obstruction to the outflow of urine from
      - stricture of urethra.
      - tumors in urethra.
      - bar at the neck of the bladder.
      - enlarged prostate.
      - calculi or other foreign bodies in the urethra.
      - tumors of the penis itself.
    - from foreign bodies in the bladder.
    - " growths in the bladder.
    - " altered urine.
    - " paralysis.
    - " over-distension or atony.
    - " displacement.
    - " disease of neighboring organs (uterus, rectum, etc.).

Suppuration of the bladder.
Abscess of the bladder.
Ulceration, simple and non-malignant, and gangrene.
Vesico-intestinal fistula.
Hypertrophy and sacculation of the bladder: dilatation.
Vesical hematuria. (See Hematuria.)

- *Tumors and growths.*
  - 1. Fibrous
    - warty.
    - polypoid.
  - 2. Villous or vascular.
  - 3. Epithelioma.
  - 4. Malignant.

Tubercle of the bladder.
Bar at the neck of the bladder.
Hernia of the bladder.
Foreign bodies in the bladder.
Calculi. (See the essay on that subject.)

[1] The Surgical Treatment of Children's Diseases. London, 1868, pp. 146–49.
[2] Vol. liii., pp. 85–131.

Inversion of the bladder.

Rupture of the bladder. (See the section on Stricture.)

2. Conditions which do not necessarily involve organic structural changes appreciable by known methods of observation, and sometimes associated with some injury or derangement of a nervous centre.

Paralysis.

Atony from over-distension, caused by { organic obstruction to outlet. / retention of urine, voluntary or involuntary, no organic obstruction being present.

"*Irritable bladder*" (*i. e.*, act of micturition abnormally frequent).

"*Spasm of the bladder*" (*i. e.*, contractions of the bladder involuntary, and exceedingly painful).

Perverted sensibility of the neck of the bladder, or neuralgia.

I shall then consider separately certain effects on the function of micturition, produced by the above-named diseases, viz.—

Incontinence of urine. { in youth. / in advanced age.

Habitual engorgement of bladder, and overflow of urine (stillicidium urinæ).

Retention of urine.

Inflammation of the bladder (cystitis): acute.—The anatomical seat of inflammation of the bladder is almost invariably the mucous membrane; occasionally, by duration or by intensity of the process, the cellular and muscular tissues external to it may be involved, and perhaps sometimes the peritoneal; but there is no evidence whatever of the existence of any separate and independent inflammation limited to or chiefly affecting the middle and outer coats, as they are anatomically termed.

The mucous membrane, situated near to the internal meatus of the urethra or neck of the bladder, is most frequently, and often most severely, affected. It is so particularly in that very common form of cystitis, viz., cystitis by extension from the urethra, as in gonorrhœa. In the most severe forms the whole of the lining membrane is affected. This may be found after death simply injected and reddened, or thickened also; or it may have become more or less dark, of a chocolate hue, or even slaty in color, as happens when the action has existed for a considerable period of time. Occasionally some lymph is exuded, and membrane-like shreds or patches, and sometimes even an extended layer of this organized product, may be found slightly adhering to the whole surface. In very rare instances such a false membrane has become the cause of retention of urine, and necessitated puncture of the bladder in the male; in the female it is sometimes thrown off entire.

Causes.—The traumatic are numerous. Injuries such as blows and pelvic fractures; operations of lithotomy, lithotrity, and ordinary catheterism; injections; in the female, prolonged and instrumental labors; mechanical irritation of calculus; the chemical action of cantharides and of some mineral poisons, and strong diuretics; action of the urine itself, retained and decomposed, as in stricture and prostatic enlargement; inflammation of adjacent parts, as kidneys, prostate, rectum (?), urethra, especially the last, giving rise to a common but mild variety; from chronic pre-existing inflammation; rarely from external cold, and occasionally from gout.

Symptoms; of the graver form, occurring after operations and pre-existing chronic disease. The invasion is ushered in by rigors, the signs of general fever, followed by perspiring skin. The desire to pass water is very frequent, sometimes quite uncontrollable; the act is excessively painful, often accompanied by rectal pain and tenesmus. Pain is constant behind the pubic symphysis and in the perineum and in the penis; also in the sacrum and loins; sometimes in the groin and upper part of the thigh. There is tenderness to supra-pubic pressure, often on the lower half of the abdomen, the patient's legs being raised to relax its parietes; much pain is produced by rectal examination, still more by catheterism. The urine is at first high-colored, scanty, and clouded; then obviously reddish, like the washings of raw meat; soon purulent and loaded with shreds; while the blood-tint continues, perhaps deepens. Meantime the patient's condition becomes low; he is often delirious; and if the disease is not checked, he dies in from seven to fourteen days. The attack is frequently fatal.

The symptoms of the milder form, which occurs by extension from gonorrhœal inflammation of the urethra, are chiefly local. They are, painful irritability of the bladder, sometimes very distressing; supra-pubic pain; pains in the sacrum, perineum, and thighs; loss of appetite, but not always marked fever. The want to pass water must be complied with instantly, and is extremely painful. The urine is cloudy, and deposits more or less mucus and pus. It may be fairly supposed that in this group of symptoms the mucous membrane of the neck of the bladder is chiefly affected, and not that of the entire viscus; the most common termination is resolution; while in the more serious form described above, the whole of the mucous membrane is affected, and

perhaps some of the tissues subjacent; it may also become ulcerated or gangrenous in the worst cases.

Treatment, of the milder form. A tolerably active mercurial purge at the outset. Leeches to the perineum, if the attack is rather severe, followed by hot poultices, and perfect rest in bed. Hot hip-baths twice a day, 100° to 105°, or more. A moderate supply of diluent drinks,[1] as barley-water or linseed-tea, with a little citrate of potash, say one drachm daily; no saline diuretics, but small doses of antimony, at the outset only, if the attack be severe. Hot linseed-poultices to the hypogastrium, if there is much pain there. If the irritability of the bladder is great, half-drachm to one-drachm doses of the tincture of hyoscyamus every two or three hours should be taken until it is mitigated; this failing, opium and hyoscyamus suppositories or small enemata may be administered. The diet should be light but not lowering. As the acute stage passes off, the effect of buchu may be watched, in one or two ounce doses four times a day, and then of small quantities of tincture of cubebs in addition, or of capivi, giving twenty minims of the former, or five to eight of the latter, thrice daily. In the severe form, the treatment advised above is to be adopted at the commencement; but if the general fever heightens, and symptoms of depression appear or threaten, support and alcoholic stimulants must be given freely, and large hot local fomentations, constantly maintained, should be substituted for the hip-bath; morphia, by the mouth, is usually necessary to tranquillize the system, with warm enemata, daily, to unload the bowels. Retention must be watched for, and the catheter, a soft gum-elastic one, employed if necessary; but never unless it be really required. If there are signs of renal inflammation, the appropriate local treatment must be vigorously applied.

Cystitis resulting from cantharides locally or internally absorbed comes on usually within two to four hours after the dose; the symptoms resemble those of gonorrhœal cystitis, soon reach their maximum of intensity, and subside in from six to twelve hours. When at the worst, the spasmodic ejection of the urine, as soon as a few drops have accumulated in the bladder, is excessively painful. If the dose has been large, blood appears in the urine, but not otherwise; sometimes shreds of lymph also. The treatment consists in bicarbonate of potash and full doses of hyoscyamus every half-hour for three or four hours, and perfect rest; all movements of the body aggravate the symptoms. It is highly important, if a blister has been the cause, to remove it at once, and to sponge well the surface in order to detach every particle of the cantharides which may be adhering to the skin.

Chronic cystitis.—Of all urinary affections, this is one of the most common, since it is apt to complicate almost every other at one time or another. Its causes also are numerous and varied. First of all, on the subsidence of the acute form, a chronic condition commonly supervenes, and may continue for a very considerable period. Next, all forms of obstruction to the exit of urine produce chronic cystitis, by confining the urine until it becomes slightly decomposed, and consequently irritating to the mucous lining of the bladder. The condition is intensified if the contractions of the bladder are also unusually frequent and painful. Inability to empty the viscus, from paralysis or atony, when no obstruction is present, acts in a precisely similar manner. If the urine is unduly acid or alkaline; if it be loaded with deposits from the kidney; sometimes if diluted or watery; if it be morbid, as in Bright's disease, or charged with irritating matters, such as diuretic salts, etc. —chronic cystitis may be induced. Foreign bodies in the cavity of the bladder powerfully excite this disease; also tumors of all kinds, simple and malignant. Diseases of the rectum sometimes, such as piles, prolapsus, and cancer, those of the uterus also, by causing pressure, and, *à fortiori*, when implicating the coats of the bladder, are among well-recognized causes. The bladder is sometimes, although rarely, displaced by adhesion to neighboring parts, as to the intestine, usually to a portion of the lesser bowel; or it may be forced into a hernial protrusion; in either case its contents are partially retained by pressure, and thus produce more or less of the affection in question.

The structure affected is the mucous membrane lining the bladder; rarely is any other implicated. After long-persisting inflammation, it is thick, velvety, and dark in color, its vessels being loaded, while the underlying fibres are usually hypertrophied. Chronic or subacute cystitis appears in two distinct forms: the

[1 In this country, where it may be obtained freshly from the springs, Bethesda, or Poland water, used freely, is unquestionably a better diluent drink in most cases than any of those ordinarily used. The hot poultice over the abdomen may also be very advantageously substituted by the flat rubber bottle, containing a thin film of very hot water. The effect is the same as that of a poultice, and the convenience of the application very much greater.]

first, an ordinary inflammation, in which a more or less active hyperæmia, hypersensibility, and very slight increase of secretion, are the main elements; the second, often a condition succeeding to this or to the acute form, in which a passive or congestive hyperæmia from local debility in the capillaries, some hypersensibility, and an *inordinate secretion of mucus* mingled with pus in varying quantity, mark the complaint. The latter form is popularly recognized as "catarrh of the bladder," and is sometimes called cystorrhœa.

The first, or *simple chronic cystitis*, is in fact the condition which exists in most cases of irritable bladder, be the cause what it may. Wherever undue frequency in micturition exists with increased mucous secretion from the bladder, however small the amount (the signs of the acute disease being absent), there is present subacute or chronic cystitis. Pus also is always present, capable of being detected by the microscope, in these circumstances: and is therefore by no means a matter of grave import, as it is often taken to be. Any source of irritation in or near the bladder may give rise to chronic cystitis; and the cause being removed, the effects generally soon cease also. Ordinarily it ceases with rest, hot hip-baths, local fomentation, mild aperients, and sufficient alkali to neutralize the natural acidity of the urine or nearly so, not to render it alkaline; if necessary, the use of buchu, triticum repens, cubebs, or capivi, in small doses, may be adopted. The second and more severe form of the complaint, however, is that to which the question of treatment becomes wide and important.

Chronic cystitis with increased secretion: catarrh.—The condition of the mucous membrane has been already described. Respecting the nature of the discharge itself, much difference of opinion has been manifested by different writers. Its naked-eye characteristics are well known. At the bottom of the vessel into which the urine has been passed, a quantity of semi-transparent, tenacious, ropy material, very much resembling the white of an egg, is soon deposited. On pouring off the contents of the vessel, it is seen at first to adhere to the sides; but soon it slides down in a mass, almost resembling jelly, and then falls out suddenly and heavily. This material has been regarded by some as simple mucus; by others as prostatic secretion; and more recently as merely pus altered by an alkali. None of these descriptions appear to be correct. No doubt it contains a considerable admixture of pus; but it is by no means identical with a specimen of that secretion to which alkali has been added, although there is a strong apparent resemblance between the two products. The mucous membrane of the bladder in these cases appears to secrete, as the bronchial membrane is also prone to do, much of a homogeneous structureless fluid, containing numerous pus corpuscles and young epithelial cells; but the proportion of the liquor to the corpuscles is much larger than in ordinary pus. The old term, mucopus, describes it perhaps more correctly than any other.

Causes.—An attack of acute cystitis; permanent obstruction of any kind, causing retention, stagnation, and decomposition of the urine; calculi and other foreign bodies; tumors in the bladder; spinal paralysis, not only as a cause of retained urine, but as occasioning perverted action of the mucous membrane by impaired nervous supply; and all causes which produce a long-continued irritation of the organ.

Treatment. — The inflammation is of chronic and atonic character; depletion and antiphlogistic remedies are therefore contra-indicated. On the contrary, the treatment should be mainly tonic and astringent. It is also more topical than general, since the remedies taken internally appear to act mainly, if not entirely, by their local influence, impregnating the urine which is retained in the bladder. It will nevertheless be advantageous to regard it under two heads, as topical and as general treatment.

1. *Topical treatment*, strictly so-called. One important indication in the treatment of this affection is to maintain the mucous membrane of the bladder as free from inorganic or other deposit as is possible. The urine itself also, if alkaline and irritating, must not be permitted to remain in constant contact with the diseased membrane. It is therefore desirable to introduce the catheter for the purpose, first, of insuring the complete contraction and evacuation of the bladder, if its own efforts do not accomplish this; and secondly, to remove morbid deposits by injecting warm water, and washing out the interior of the viscus. This is often productive of great comfort to the patient; and increased benefit may sometimes be obtained by cautiously impregnating the water so employed with astringent or sedative agents. Of the former kind, one of the best is the acetate of lead, commencing with one-sixth of a grain to the ounce of water; next to this, the nitrate of silver, commencing with one grain to eight ounces of distilled water; or nitric acid may be used, in the proportion of ten minims of dilute acid to four ounces of water. By slow degrees the nitrate may be increased as far as to one grain to the ounce in some obstinate cases, and with much advantage. After

washing out the bladder with plain water, at a temperature of about 98° or 100° (a gum catheter and India-rubber bottle, with nozzle and stopcock, is the best apparatus), about two or three ounces of the fluid, which should have the same temperature, should be slowly injected, and, after remaining two or three minutes, be allowed to flow out. Two or three drops of carbolic acid to half a pint of water is a useful injection when the urine is fetid.

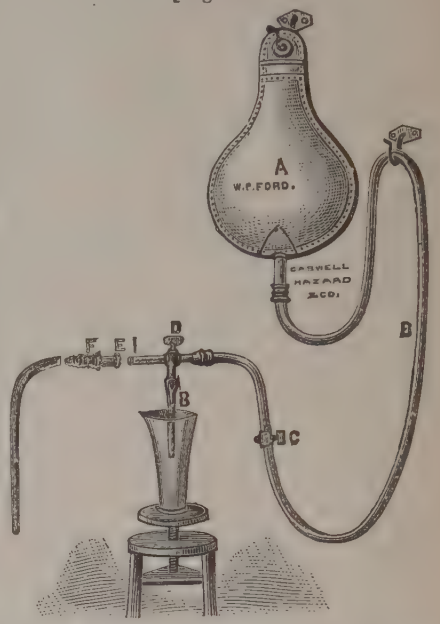
Anodyne solutions may be used, but are of small value. I have employed the following: Dissolve one drachm of each extract, conium and hyoscyamus, and half a drachm of extract of opium, in two drachms of proof spirit and fourteen drachms of water; of this solution add a sixth or a fourth part to three ounces of warm water for an injection, to remain in the bladder five minutes; two-thirds should then be permitted to flow out, and the catheter withdrawn; the rest is retained in the bladder.

All the manipulation connected with these processes must be of the most gentle kind; otherwise more harm will be done by the manual interference than good by the therapeutical element. And where the plan is manifestly not producing some marked benefit after a few trials, and *à fortiori*, if it increases the symptoms, the application must be discontinued.

[Probably it will give most satisfaction to a patient when the nature of his case is such as to require more or less irrigation of the bladder during a long period, and where self-injection becomes a necessary part of the treatment, to use a fountain syringe with a two-way stopcock, instead of any other variety of syringe. Fig. 433 represents such an instrument attached to a soft rubber catheter. The catheter most suitable for continued use by a patient upon himself is the velvet-eyed soft-rubber catheter, made by Tiemann, of New York—when a soft-rubber instrument will pass, otherwise a Mercier elbowed soft catheter. The use of a fountain obviates all shock to the neck of the bladder, allows the viscus to be moderately distended until the feeling of a desire to urinate is experienced, when by turning the two-way cock the bladder empties itself, and may be refilled and emptied again and again until it is clean, with no further trouble than that of turning the button of the stopcock.]

It should be borne in mind, however, that on all occasions of washing out the bladder, a small quantity of liquid only, such as two to three ounces, is to be injected. This may often be highly useful, while the employment of double this quantity may be productive of nothing but mischief. The bladder is usually more or less irritated by throwing in so much as five or six ounces; and it is on this account that I have long ceased to employ injections in lithotrity, a plan attended with no little benefit.

[Fig. 433.



A. Bag holding from one to three pints, to be hung about six feet above the floor. D. Two-way cock of metal. F. Nozzle of hard rubber. The water placed in the bag should have a temperature of about 110° F., as it loses from 10° to 20° in passing from the bag to the bladder.]

Counter-irritation is not very manageable in these cases, although sometimes useful. I have employed a Burgundy pitch plaster, croton-oil in soap liniment, and strong tincture of iodine, over the pubes, the latter to the perineum also, with some advantage, after shaving the hair. Cantharides, it is said, must be avoided; but I have found no disadvantage from its application to the perineum in the form of the strong acetum lyttæ; and where the inflammation chiefly affects the neck of the bladder, it has sometimes an excellent effect. No better application to the pubes for general purposes exists than a hot linseed-poultice, the surface of which has been sprinkled with mustard.

The pain and loss of sleep often present demand the use of opiates either by mouth or rectum, and generally also such use of aperients as the system demands in consequence. Each case requires often a different treatment; some experiencing more relief from opium by the mouth, others from suppositories or small ene-

mata. Opium alone, or with belladonna, or conium, or hyoscyamus, may be administered often with the best results, through the rectum, and with a most tranquillizing effect on the bladder.

2. *Internal remedies.*—Among the most popular are the infusions of buchu and uva ursi, and the decoction of pareira brava. The indications for their use appear to be the following: chronic mucous discharge from the bladder in large quantity, associated with relaxation and debility, no inflammation being present, may be controlled by the astringent tonic uva ursi; or this agent may be employed with equal parts of decoction of pareira. Chimaphila is considered by some appropriate in this complaint. The decoction of senega is perhaps superior. In this state also small doses of copaiba or oil of cubebs diminish the secretion considerably. When micturition is frequent, the urine is cloudy, and inflammation is present, a pint daily of decoction of triticum repens (two ounces to the pint), or a half-pint of the infusion of buchu during the same period, may afford great relief.

Dr. Gross employs a combination, sometimes useful in irritable and inflammatory states of the bladder. One ounce and a half of the leaves of uva ursi, and half an ounce of hops, are infused in two pints of boiling water in a covered vessel for two hours; a wineglass to be taken several times a day.

Demulcents are useful by diluting the renal secretion, at the same time that they furnish some little nutriment to the body, and in some instances, perhaps, exert some special therapeutic influence. They are also agreeable vehicles for the administration of acids, alkalies, and other agents, when these are required. Among the most useful are the decoction of marsh mallow, or of the common mallow in its absence; the decoction of carrageen, or Irish moss; the infusion of linseed; the infusion of the bark of slippery elm; the decoction of barley, better known as barley-water; and a solution of gum arabic in water.

The alkalies and the acids are valuable remedies when appropriately given. The old rule of administering the former when the urine is too acid, and the latter whenever it is alkaline, is not to be followed. No doubt, when there is an excess of acid, it may be most effectually diminished and nicely controlled by the alkaline bicarbonate, as well as by the tartrates and citrates; but this is rarely the case in chronic cystitis. It is far less easy to neutralize the alkalinity of urine, the condition most constantly present in catarrh. Some benefit is, however, occasionally to be obtained from small doses of the alkali, even when the urine is alkaline from large admixture of mucous secretions and decomposition of urinary salts in the bladder. If the urine is secreted with its full amount of normal acid, or with excess, it is liable to irritate a vesical mucous membrane whose sensibility is already exalted by inflammation. Hence Dr. O. Rees has proposed to give in such cases enough alkali, such as the citrate of potash, to neutralize the acid reaction of the urine, so that this cause of irritation may be removed; and in some cases a certain benefit is thus attained. Care must be taken, however, not to produce alkalinity of the urine, which it is our object to diminish. The mineral acids have little or no influence on the reaction of the urine. Large quantities of nitric or of hydrochloric may be given, without producing any result whatever. The benzoic acid is excreted by the kidneys, but a large quantity of this insoluble drug must be taken to acidify alkaline urine. Lemon-juice in full quantity has a similar effect. Alkaline urine chiefly depends on mechanical obstruction, and local treatment is mainly required.

In almost all instances, the patient should have light and nutritious diet; and sometimes the moderate use of stimulants is called for. It is of great importance to maintain the digestive system in good order, and to avoid obstruction of the abdominal viscera; an occasional dose of blue-pill is sometimes very serviceable to the patient. Rest in the recumbent position, and abstinence from all exertion, especially walking or riding, are in themselves matters of the first importance in treatment.

Suppuration of the bladder is that condition in which the catarrh, already described, consists mainly or entirely of a purulent secretion. It is to be treated chiefly with local mild astringent injections, and has been sufficiently considered with the last subject. The larger the proportion of pus in the fluid of catarrh, the graver is the existing affection.

Abscess of the bladder.—Occasionally deposits of pus occur in the walls of the bladder; these are always the result of pre-existing severe disease, usually of a chronic character. Their existence is rarely to be diagnosed or even suspected during life, and no special treatment is indicated.

Ulceration of the bladder.—This is by no means a common affection, and seldom occurs, except in the last stage of urethro-vesical disease, arising from obstruction when, after long-standing inflammation of the mucous membrane, ulceration takes place. It may result also in advanced tubercular and malignant diseases of the

bladder; the ulceration following softening of the tubercular deposit and disintegration of the cancerous growths. A simple form of ulcer has been observed to occur from permitting a silver catheter to remain with a large portion of the instrument within the cavity of the bladder, upon the mucous membrane of which it has rested or impinged for some days. Signs of ulceration are, blood in the urine, severe pain at a fixed spot, constitutional depression, usually soon ending in death. The urine contains débris of mucous membrane; and if the ulcer increases rapidly, or the tissues become gangrenous, there is much fetor and dark sanious matter mixed with the excretion. Instrumental explorations are exceedingly painful; there is constant desire to pass water, and the effort produces often severe agony.

Treatment.—Stimulants and support for the general condition; full doses of opiates, by mouth and rectum; small doses of alkali internally, and diluents; no unnecessary mechanical interference to be permitted.

Vesico-intestinal fistula.—Fistulous openings sometimes form between the bladder and some portion of the intestinal canal. The result is, that some of the liquids from this latter source enter, at first in minute quantity, and give rise usually to much irritability of the bladder, and other symptoms of subacute cystitis. These are sometimes the earliest signs of the existence of an abnormal communication. If the urine is examined at this early period, fragments of vegetable and of animal fibre may be discovered under the microscope. I have myself been able to diagnose at an early stage, in otherwise doubtful circumstances, the existence of vesico-intestinal fistula by this means. Usually the symptoms become gradually more severe, and the fecal odor and color are communicated to the urine. At length, considerable fragments of fecal matter enter the viscus, become partially dissolved there, and pass through the urethra. I have seen several cases of this distressing condition, both in the male and in the female, but chiefly in the former; and in these, carcinomatous disease in the abdomen has been the most frequent but not the only cause. Thus, adhesion may take place between an ulcerating bowel and the bladder; and the ulceration may extend into the latter, no cancerous disease being present.

Treatment.—Little can be said in relation to this matter. The lesion having been determined, instrumental interference is—except under special necessity, such as for the purpose of removing foreign bodies from the bladder, which are a source of great misery—to be shunned. The use of purgatives is also to be avoided; but the bowels should be maintained, as far as possible, in the natural condition. The food is to be such as will nourish the body without producing a large and coarse residue of fecal matter. In one case under my own care, in which a gentleman passed for several months the whole of the feces by the urethra, a great amount of suffering was occasioned by swallowing indigestible substances, like grape-stones and husks. Subsequently, by a careful selection of fluid nutriment, the most painful features of the case were much ameliorated. Now and then washing out the bladder with small quantities of tepid water gently thrown in contributed to the patient's comfort. In this case the ulceration was not due to cancer.

For some of these cases of non-malignant disease another form of treatment remains. When it can be determined that the fistulous passage connects the bladder with the rectum, or with the sigmoid flexure of the colon, the propriety of opening the descending colon (Amussat's operation) ought to be considered. In one case, recorded in the Medical and Chirurgical Transactions, vol. xxxiii., Mr. Pennell, of Rio Janeiro, performed this operation with success, diverting the passage of feces from the bladder by the artificial anus. More lately Mr. Holmes has achieved a similar success in a case in which the fistula was believed to exist low down in the colon. It is reported in the same Transactions, vol. xlix., p. 66 et seq. The point to be determined, if possible, before operating, is whether the communication exists between the small or the large intestine or rectum, and the bladder. If it is in the descending colon or below, urine will probably issue at some time or another per rectum; if the small intestine is the seat of ulceration and opens into the bladder, no urine can be expected to issue by the bowel. In favorable cases, then, this proceeding should certainly be adopted.

Hypertrophy and sacculation of the bladder, dilatation, etc.—The muscular walls of the bladder become hypertrophied in most cases of obstruction to the outlet. Increased force being necessary to expel the urine, the organic fibres are augmented in proportion to the action required. Hence the vesical coats may be seen rugose and columnar, resembling in appearance the left ventricle of the heart; and they may reach half an inch, and sometimes even an inch in thickness. From the interlacing of the fibrous bands which constitute the parietes of the bladder, it often happens, when hypertrophy

exists, that the mucous membrane is forced by pressure into the interstices between, and that gradually sacculi are formed. These at first are very small,

Fig. 434.

A large sac projecting from the right side of the bladder. The communicating orifice just admits a common quill. Cause, long-standing hypertrophy of the prostate, the three portions seen to be enlarged below. *a*, prostate gland divided. *b*, cavity of sac laid open.

but if the action is continued and powerful, they become large in size, protruding, in the form of tumors, beyond the periphery of the bladder, and forming additional reservoirs for the urine. A sac, or sacculus, may thus sometimes attain the size of a healthy bladder, although the communication with the original viscus is by a comparatively small orifice. When large, its structure is chiefly mucous membrane and cellular tissue; here and there a few muscular fibres sometimes cross the tumor. Sacculi not unfrequently become receptacles for calculi, and are always so for urine, which is unduly retained by them, and becomes a source of irritation. There is no special sign by which their existence can be certainly diagnosed, although it may be suspected; neither is any specific treatment requisite beyond that necessary to all those cases in which the bladder fails to expel its contents, and is the subject of chronic inflammation.

In addition to hypertrophy, the walls of the bladder are sometimes thickened by an interstitial deposit of lymph from inflammation; a circumstance which impairs, and almost destroys, the muscular action of the viscus. Very frequently the bladder is simply dilated, and even distended, as a result of obstruction, the walls being thinner instead of thicker than natural. This condition occurs, not in stricture, but in those cases of enlarged prostate where, by reason of the size of the prostatic mass implicating the muscular apparatus at the neck of the bladder, the viscus is incapacitated from contracting, and suffers passive distension. Hypertrophy does not then take place because muscular action is impossible, or nearly so.

Vesical hematuria. (See Hematuria, p. 751.)

Tumors of the bladder.—These affections may be classified as follows:—

1. Fibrous growths, of a warty and of a polypoid character.
2. Villous or vascular growths.
3. Epithelial growths.
4. Malignant growths.

1. *Fibrous growths* are rarely met with, but the few specimens preserved in our museums indicate the classification presented here. They are non-malignant in character, causing injury and almost always death solely by the obstruction they occasion to the urinary outlet. They are connected with the mucous membrane and submucous tissue, and are made up of elements normally belonging to the latter. They appear to commence in the form of a simple circumscribed elevation of the mucous membrane, resembling a warty growth; and, subsequently, they enlarge, protrude, and assume a polypoid form. A single anatomical preparation may afford examples of all stages of development between the earliest elevation and the fully formed polypoid tumor. There is no analogy whatever in origin or structure between them and the uterine growths; nor between them and the polypoid outgrowth, which is frequently found springing from the posterior part of the prostate.

The *symptoms* are those common to all forms of obstruction to micturition, added to the special signs of foreign body in the bladder. Careful sounding may detect their position and form, and will prove the absence of stone. The complaint is most frequent in children and young people. Unlike the villous and the malignant growths, they rarely give rise to blood in the urine.

Treatment.—No special curative treatment is applicable in the male subject of these growths; much may be done to palliate the symptoms and to support the powers of life, by adopting those means which are fully detailed in considering the effects of obstruction under the heads Stricture, Enlarged Prostate, and Chronic Cystitis. In the female, a growth of this

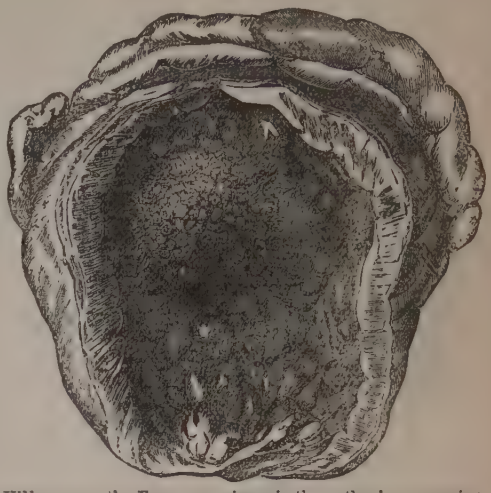
kind has been removed by ligature, the urethra easily admitting the requisite degree of dilatation.

[In the male of late years there have been several successful cases of removal of myomata (sometimes called fibromata) from the bladder. Billroth successfully removed such a tumor, eight centimetres long and four broad, from a boy of twelve years, by the combined lateral and high operations.[1]

Volkmann failed to save his patient, a man of fifty-four, from whom he removed a myoma as large as a hen's egg by the high operation.[2] G. M. Humphry successfully removed a similar growth as large as an orange, from a man of twenty-one, by the lateral operation.[3]

Specimens in Guy's Hospital demonstrate the existence of pedunculated myxomatous polyps. The surgery of the future will doubtless justify operation in all cases of pedunculated growths within the bladder.]

Fig. 435.



Villous growth. From a specimen in the author's possession.

2. *Villous growths.*—These have usually been classified as "malignant," but have no claim, either by their structure, their action, or by the presence of constitutional cachexia, to be so considered. The villous growth of the bladder is a soft, flocculent body, about the size of a large marble when fully developed, made up of innumerable villous processes, floating in water and branching off in every direction from the base, which is connected solely with the mucous and submucous tissues. These villi are identical in structure with the villous processes of the chorion in its normal state, and are very vascular. Several such tumors may coexist in one bladder; and the whole or a large portion of the mucous lining of the organ may, if closely examined, be found more or less studded with small villous processes, similar to those of the tumor itself.

The *symptoms* have nothing special to distinguish them from those of other tumors, excepting the frequent or almost constant appearance of some blood in the urine without provocation. Indeed, death occurs rather from hemorrhage than from obstruction in these cases, as well as in part from the exhaustion which pain induces. Pain, however, chiefly depends on the amount of obstruction occasioned by the growth; if this is situated so as not to interfere much with the outflow of urine, pain is not necessarily severe. Small shreds are frequently found in the urine, which, under the microscope, sometimes present appearances indicating the nature of the disease. The growths are too soft to be identified by the sound, and instrumental interference almost always greatly aggravates the symptoms.

Treatment.—The indications are, to allay pain, to subdue spasmodic action of the bladder, to prevent hemorrhage by internal remedies, and to counteract its effects on the system by chalybeates and nutritious diet. Astringent injections very carefully introduced into the bladder, such as weak solutions of acetate of lead or of nitrate of silver, may be tried; they are, however, not to be repeated more than once or twice, unless marked benefit is observed, and signs of vesical irritation have not been produced by their employment.

[Robert S. Hudson reports[1] a case of villous growth lasting eleven years. The first hemorrhages were treated by injections of nitrate of silver at intervals during several weeks. The patient then recovered and remained well during eight years. Then the bleeding recurred, and terminated life in three years, when an autopsy revealed eight pedunculated growths in the bladder. Alexander[2] claims to have wired off this variety of tumor through a dilated urethra in the female with success, and refers to a case in the male as having been successfully operated on by Billroth.

Kocher,[3] of Bonn, reports a successful

[1 Archiv f. Klin. Chir., Bd. xviii., s. 411.]

[2 Archiv f. Klin. Chir., Bd. xix., s. 682.]

[3 Med.-Chir. Trans., 1879, vol. lxii., p. 421.]

[1 Dublin Journ. of Med. Sci., June, 1879.]

[2 Lancet, Aug. 17, 1878, p. 209.]

[3 Centralblatt f. Chirurgie, April 1, 1876.]

operation upon the male by scraping with a sharp spoon through a perineal incision. The case is reported fifteen months after the operation, at which time the patient was well.]

3. *Epithelioma.*—This is a rare affection, and appears to be of slow growth.

A preparation which I exhibited at the Pathological Society was from the body of a patient who certainly had been the subject of it eight or ten years. In his case the symptoms resembled those of stone, only that the slightest degree of movement produced bleeding, in the later stage. Injections of nitrate of silver, from the half of a grain to one grain to the ounce, controlled this tendency remarkably, and enabled him to walk a mile or two without hemorrhage. After death the same deposit was found in one kidney. (Path. Trans., vol. xviii., pp. 162–4.)

4. *Malignant disease of the bladder* is more frequent than the growths just described. Sometimes it is primary, commencing independently in the bladder; at other times it is secondary, extending from the prostate, from the uterus, or from the rectum. The species may be scirrhus, but is usually encephaloid when originating in the bladder; always the latter when spreading from the prostate; when from the rectum, it is commonly scirrhus; from the uterus, the same, or epithelioma. Colloid is said to have existed, although it must be extremely rare. The disease generally runs a rapid course, and presents the constitutional characters significant of malignant action. In cases of encephaloid a large mass is soon formed, which sometimes almost fills the cavity of the bladder.

Symptoms.—One of the most strongly marked signs of this affection is hemorrhage into the bladder, generally occurring suddenly and in large quantities, rather than by frequent or continuous oozings from capillary vessels, which latter mode is more characteristic of villous growths. The pain is also very severe and lancinating, and is referred as much to the loins, back, and thighs as to the pubic and perineal regions. All the signs of obstructive disease and chronic cystitis are present. Constitutional cachexia accompanies the local disease in its advanced stage; glandular enlargements are usually distinguishable in the iliac regions; and the patient suffers from loss of blood and rest. Small portions of disintegrated tissue and bloody sanies are often voided from the bladder; occasionally cells may be found in the urine, which, when examined by the microscope, seem to indicate the specific character of the disease; but the diagnosis is generally tolerably clear without the somewhat questionable support which is to be derived from this source. Without in any respect undervaluing the utility of microscopic examination, I am compelled to conclude that too much stress must not be laid on the indications which cell-growths in the urine afford in respect of the presence of malignant or non-malignant disease in the urinary passages. When large masses of soft growth, however, are frequently passed, made up of large cells with more than one nucleus, the diagnosis of cancer is strongly confirmed.

The principles of *treatment* vary in no respect from those which have been laid down under the head of villous tumors. Opium in some form, administered both by mouth and by rectum, and occasionally by injection into the bladder, is of great value in alleviating the severe suffering; and must usually be given towards the later stages of the complaint with great freedom. In all those complaints of the urinary organs where little or nothing remains to be done but to alleviate pain and support the powers of life, the remedies necessary should be given with no sparing hand. So severe is the anguish which the patient suffers if left to the action of his complaint, unchecked or only partially checked by anodynes and anæsthetics, that it must be regarded as cruel to deprive him of their aid in mitigating his distress, so far as they can be made available without danger to life; while at the same time alcoholic stimulants are in some cases scarcely less valuable than opium in enabling him to endure the progress of his malady.

[In many conditions of malignant disease the neck of the bladder becomes involved, and the new formation becomes a mechanical obstacle to urination, some time before the patient's vitality has been destroyed by the disease itself. Under such circumstances a permanent opening should be established either above the pubes or through the perineum, and a silver tube should be worn to prevent closure of the wound. In this way life may be prolonged, and much suffering averted.]

Tubercle of the bladder.—One of the rarest of the affections of the bladder is tubercular deposit; probably it never occurs unassociated with tubercular disease in other parts of the body: indeed, in almost all—perhaps it may be said in all—cases, other parts of the urinary system are similarly affected, and these are generally the kidneys and prostate. In women it has been found to have followed primary disease in the uterus. The disease commences by a deposit in the coats of the bladder of small tubercles; these

become numerous, and coalesce; subsequently the morbid material softens, the mucous membrane gives way, disintegration takes place, and a ragged ulcer ensues, a large extent of the inner coat being sometimes destroyed before death.

The symptoms of this disease are not peculiar, and the diagnosis depends rather on negative than on positive signs. The absence of much or frequent hemorrhage may serve to distinguish it from malignant and villous tumors. Great pain and extreme irritability, frequency in making water, the absence of calculus or other foreign body in the bladder, as ascertained by sounding, together with the presence of tubercle elsewhere, and progressive emaciation, and lastly the patient's age, usually early or middle adult life, will serve to indicate the true character of the disease.

Treatment.—That which is adapted for constitutional tuberculosis in relation to the general health. For the local complaint, anodynes, the remedies for chronic cystitis, rest; and no mechanical interference when the diagnosis is tolerably clear.

Bar at the neck of the bladder.—The enlargement of the prostate, common in old age, often produces an elevation of the structures, sometimes amounting to a distinct ridge, which exists at the inferior aspect of the neck of the bladder. A bar may be thus said to be formed there; nevertheless, it has not been usual in this country to apply that term to any product of the enlarged prostate; it has been thought more desirable to reserve it rather to denote any bar which may exist in the spot described, but which is not prostatic in its character. Such bars occasionally exist, and usually in elderly subjects. Mr. Guthrie was the first to point out this fact. He believed the bar to consist in disease of "the elastic structure," existing at the neck of the bladder, and as such to be quite distinct from the very common complaint already referred to. After considerable study of this question, I cannot but consider the non-prostatic bar as extremely rare, since almost all permanent obstructions at the vesical neck are due to enlargement of the gland or to its effects; nevertheless, in very exceptional instances the bar in question is undoubtedly to be met with.

In all long-continued diseases of the urethra and bladder it is common to find a hypertrophied condition of the uvula [vesicæ] and associated muscular fibres, and more or less elevation at the neck of the bladder, or bar, as its consequence; but this is not to be regarded as an example of the disease in question.

The treatment mainly consists in combating the symptoms of chronic cystitis which may arise, and occasionally passing a large catheter, so as to insure a patent condition of the neck of the bladder. Mr. Guthrie and others have proposed to divide the bar by incisions; but the rarity of any true barrier here, apart from prostatic enlargement, will induce extreme caution in affirming positively the presence of this affection during life, and any severe surgical operation for its relief could only be contemplated in presence of very serious symptoms as its undoubted effects. The subject of operations for relief of obstruction at the neck of the bladder is considered at the close of the section devoted to treatment of the enlarged prostate of age.

Hernia of the bladder is a rare affection, liable to occur in both sexes: in the male, as inguinal; in the female usually as vaginal hernia, although it may be femoral. In the former it generally forms part of a large mass occupying the scrotum, pressure on which sometimes evacuates the portion of urine which is liable to be retained in that situation, the bladder occupying in part the pelvis, and in part the scrotum. It may be associated with a hernial protrusion of bowel, or may exist independently of this. In the former condition it has been met with in the operation for strangulated inguinal hernia, and has even been opened by mistake, as in one of the two cases recorded by Pott. The portion of bladder forming the hernia always escapes from beneath the peritoneum, and consequently is never found covered by that structure. In cases which are detected early, a truss may be successful in retaining the viscus within the pelvis; where permanent adhesions in the anomalous position have taken place, mechanical support is to be applied to prevent further protrusion.

Inversion of the bladder.—This is an exceedingly rare affection, and is found exclusively among female children. Three cases only have come to my knowledge;[1] their ages when first seen were from two to four years, although the condition probably commenced at a very early age. The bladder is gradually prolapsed and protruded through the urethra, which becomes much distended, until the viscus presents the appearance of a pyriform, red, and vascular tumor. One of these cases narrowly escaped the application of a ligature, on the supposition referred to; but on careful examination the orifices of the ureters were discovered, and reduction was accomplished by manual press-

[1] Lond. Med. Gaz., 1833, Jan. 19; Trans. Prov. Med. and Surg. Assoc., 1846, by Mr. Crosse, with plate; Lancet, 1862, vol. i., p. 250, by John Lowe, M.D.

ure. Considerable incontinence existed subsequently in the two former; but in the third it occurred to the surgeon (Dr. Lowe, of Lynn) to apply a heated iron to the urethra (in all five times), and to maintain a silver catheter with a bulbous extremity in the bladder, between two and three weeks; by which means the viscus was maintained in its place, and cicatrization of the dilated canal ensued. The bladder was enabled subsequently to retain some ounces of urine, and slight incontinence only remained.

II. *Conditions which do not necessarily involve organic structural changes, appreciable by known methods of observation, and which are generally associated with some injury or derangement of a nervous centre.*

Paralysis of the bladder.—One of the most common terms used in relation to complaints of the bladder is paralysis. Yet true paralysis of the bladder never occurs without some lesion of a nervous centre; so that the word is often incorrectly employed. For example; the bladder when unable to evacuate its contents, from obstruction by stricture or by prostatic enlargement, or by atony from over-distension, is commonly said to be "paralyzed," although there is no derangement of the nervous supply; to which condition the use of that term ought, in accordance with our employment of it elsewhere, to be limited. The bladder may possess its normal contractile power, but be unable to overcome an abnormal obstacle in the outlet, and so fail to expel its contents; the complaint in this case is not paralysis of the bladder, but solely obstruction in the channel of exit—two totally different conditions. This distinction must be clearly kept in view in our consideration of this subject.

True paralysis of the bladder is a condition in which the contractile power of its muscular fibres is lost or impaired from failure of nervous supply; thus there may be partial as well as total paralysis. The usual cause of this accident is cerebral or spinal lesion. It happens in some injuries to the brain, in almost all serious injuries of the spine, in softening, in apoplexy and in all serious organic affections involving those parts of the cerebro-spinal system which affect the urinary apparatus. It occurs from spinal debility produced by excesses, especially of a sexual kind; also in temporary functional derangement of the nervous centres; through the agency of reflex action from some adjacent source of irritation, as in hemorrhoids, and especially after operations for their removal; and after other operations; although in some of these cases the retention is probably due rather to spasm of the constrictor muscles than to paralysis of the bladder. It may also happen after shock to the system from any source, in fevers, etc.

I have met with a single case of permanent loss of power in the bladder attributed to an overdose of belladonna. Certain it is that the effect of hyoscyamus and belladonna is frequently to produce temporary paralysis; and in this manner they combat undue irritability of the organ, for which they are so constantly prescribed. I repeat then that there is no true limited or local paralysis (the temporary conditions just referred to only excepted) of the bladder, either affecting the body of the organ alone, producing retention; or its neck alone, producing incontinence; or of the entire organ, the result of which is also retention unassociated with paralysis of other parts or organs. Notwithstanding that such conditions have been described, and regarded as common occurrences, the true pathological lesion is in almost all cases atony from over-distension, and not paralysis (see next section).

Treatment of paralysis.—From whatever cause, the first duty is to empty the bladder, by means of the catheter, twice or thrice daily. It should be employed with great care; for the patient has probably lost sensibility, and cannot indicate, by complaining of pain, when injury is inflicted; while the urethra is often in a lax state, and consequently a slight laceration is easily made. A full sized instrument, either gum or silver, whichever is found to pass most easily, must be employed. If signs of chronic cystitis manifest themselves, the appropriate remedies must be employed, especially the local ones, among which washing out the bladder, followed by very mild astringent injections, may be reckoned as the best.

In cases not traumatic, or depending upon acute disease, strychnia, steel, cantharides, ergot of rye, and arsenic deserve a trial. Galvanism, cold douches, and blistering should also be employed as local agents.

Atony from over-distension.—Organic obstruction having existed either at the neck of the bladder (enlarged prostate), or in the course of the urethra (stricture), during a considerable period, and having gradually augmented in amount, the contractile power of the bladder becomes insufficient to expel all the urine, and a portion is left behind at every act of micturition. This goes on increasing until, in some cases, the amount so remaining, technically called "residual urine," reaches twenty or even thirty ounces; it then begins to open out the neck of the bladder, and some of it runs off during sleep, or when strong muscular efforts are

made. The fibres of the bladder being unequal to the task of expelling the urine through the narrowed channel, and not having been permitted to resume the natural condition of complete contraction, are over-stretched, lose their tone, and, even on the obstruction being removed, cannot expel the contents of the viscus. A similar state may be produced when no organic obstruction is present, from long-continued retention of urine exerted voluntarily, or occasioned by temporary spasm, or by some cerebral affection, in fevers and the like. The patient whose bladder has been thus over-distended often finds himself unable to empty it subsequently. Such is the condition termed here atony, and often falsely called paralysis, as already noticed in the preceding section.

Treatment.—It is essential, in the first instance, to insure the complete emptying of the bladder for a time, at least once or twice daily. The muscular fibres must be enabled to resume their normal condition of contraction from time to time; and this never can take place unless the bladder is artificially emptied. Sometimes, if the over-distension has not continued too long, they gradually regain their tone, or at least recover much of it. When the abnormal state has existed long, it may be often greatly benefited, but is rarely completely removed. Without the mechanical aid all medical treatment is absolutely useless, but it may perhaps be useful in combination with the former. The general and local stimulants of nervous action, already advised in paralysis, should be employed in this affection also. The cold douche over the lumbar spine and on the abdomen is sometimes particularly useful. Injections of cold water into the bladder itself are the best of all direct applications to the viscus.

Irritable bladder.—This term is often very loosely employed to designate some specific affection of the bladder. Like the term "dropsy," "irritability of the bladder" denotes nothing more than a symptom; in either case the real cause must be discovered; the terms themselves conveying no meaning beyond the simple fact, in the former case that a collection of fluid is present, in the latter that the patient passes urine too frequently. Irritability of the bladder is a symptom present in almost every affection of the urinary organs, from childhood to old age; and it is named here at the head of a section solely on account of the conventional misappropriation of the term, and as affording an opportunity of protesting against it. Nothing is more common, even in professional communication, than to be asked what is the best remedy for "irritability of bladder." It denotes no special pathological state, and always requires to be considered in connection with the other symptoms which are allied with it, before a diagnosis of the existing complaint can be made.

Spasm of the bladder denotes another symptom, but this term is less frequently misapplied. It implies that the contractions of the bladder are involuntary, uncontrollable, and exceedingly painful, the cause usually being inflammation, stone, foreign growths, etc. As in the preceding instance of "irritable bladder," it is often employed to denote a specific affection when the true disease has not been discovered; but the existence of some exciting cause may be predicated as invariable. Spasm is allayed, whatever the cause may be, by general and local anodynes, anæsthetics, and antispasmodics, as described under the head of treatment for cystitis, prostatitis, and stricture, with which conditions it is liable to coexist.

Perverted sensibility of the neck of the bladder, or neuralgia.—There are a few cases of severe urinary symptoms met with in which neither researches during life nor inspection after death have revealed the nature of the affection. It is important to remark that the number of instances admitted to this category in practice, diminishes in direct proportion to the degree of skill in diagnosis which is brought to bear on obscure cases. Usually the patient complains of symptoms greatly resembling those of stone, but repeated soundings fail to detect a stone, or any other deviation from the normal state of the organs. The urine is healthy, or at most only occasionally contains traces of undue action of the mucous membrane. Errors in diet sometimes aggravate the symptoms, sometimes have no effect. Change of air and scene often produce an improvement, which unhappily is only temporary. By careful investigation, a deranged state of the liver, early stages of renal disease, the presence of hemorrhoids, commencing cerebral changes late in life, or miasmata, may be found to account for some cases; but nevertheless a few remain apparently inexplicable. Such have been regarded, for want of a better or more certain knowledge, as examples of neuralgia of the neck of the bladder. The treatment ordinarily directed to improvement of the general health, and against periodicity of attack, if such be present, is generally indicated in such cases. Palliation of severe pain is to be obtained by the usual remedies.

Incontinence of urine.—An involuntary flow of urine from the bladder may occur under two widely different conditions: the first, during sleep only, in young sub-

jects, the bladder emptying itself when the control of the will is suspended; the second occurs in adult subjects of all ages, when the bladder is already over-distended with urine, a certain quantity, which usually bears a very small proportion to the quantity retained, running off either during sleeping or waking. The following rule almost invariably holds good: in juvenile incontinence there is no retention of urine; in adult incontinence it is present to a serious extent. There is no principle more important to remember in the treatment of diseases of the urinary organs than this, viz., that *an involuntary flow of urine in the adult indicates a distended, not an empty bladder.*

1. *Incontinence in childhood and youth.*—This is a common and sometimes a very troublesome infirmity, affecting patients generally under the age of puberty, although occasionally it continues during some years after that period. The single symptom is that, in the middle of the night or towards early morning, the child wets the bed without awaking, and the act may be repeated once or a great number of times before rising. Sometimes this occurs every night; sometimes there is an interval of one night, rarely of more. The patients so affected do not appear to belong to any particular temperament, nor to be necessarily weak and cachectic. In some the failing is simply a habit resulting from want of management, such as neglecting to take up young children once during the long period which is necessary to them as a night's rest. In such cases careful attention to habits and diet may arrest the infirmity. In many cases, however, no ordinary management succeeds, and medical aid is sought.

Innumerable remedies have been given, and with a very unequal success. Small doses of cantharides and of strychnia, either with or without iron, are sometimes employed. Tincture of iron alone, or the vinum ferri, has sometimes proved successful. Blisters to the sacrum has been a favorite remedy; also cold douches to the spine, and general tonic treatment in most cases. In my own experience nothing has afforded such good results as belladonna. I have employed it in the form of extract, commencing, according to the age of the patient, with the sixteenth to the eighth of a grain twice a day, and increasing the dose if required as far as it can be safely borne. It is necessary to add, that disappointment has arisen in the use of this remedy from the impurity of the drug; it is absolutely necessary to employ a pure extract. After failure with a preparation from one source, I have quickly succeeded with one obtained from another.

In cases of extreme obstinacy, I have succeeded by applying a solution of nitrate of silver, ten grains to the ounce, to the prostatic portions of the urethra and neck of the bladder. This remedy is also easily applicable to the posterior part of the urethra in the female.

In no cases is it desirable to employ mechanical pressure to prevent micturition. Either by some of the agents already named, or by the improvement of the health, in which may be included the removal of worms, and other sources of intestinal irritation always to be looked for in obstinate cases, success may generally be attained sooner or later, although perseverance is occasionally necessary for a long period of time.

2. *Incontinence in the adult*, as has been before shown, indicates, in the vast majority of cases, a bladder distended by retained urine; the cause of which may be stricture, enlarged prostate, cystitis, stone, atony from over-distension, or true paralysis. Very rarely does it happen in the male that the urine runs off from the bladder as fast as it arrives there from the kidneys. Hence it is a cardinal principle in practice, that whenever urine runs off incontinently, a catheter should be passed to ascertain the amount of retention present, and to relieve it. In the female, true incontinence is more frequent, and is generally caused by a traumatic injury to the short urethra, which has impaired or destroyed the sphincter's action, such as sloughing from pressure in labor, or from the use of instruments to remove the child, from over-distension of the urethra in removing calculus, etc.

In regard to the treatment of incontinence, it is unnecessary to recapitulate that which is appropriate to the various conditions above mentioned as causes of an unnatural flow of urine from the bladder, since they have been considered under their various headings. When that rare affection in the male adult, true incontinence, maintaining the bladder in a constantly empty state, is really present, the cause will be sought either in some perverted action of the nervous centres, or in a certain rare form of prostatic enlargement in which the phenomenon in question does occur. Supposing that there is no local organic disease to be found in the urinary organs, the nervous centres alone can be held responsible for the symptom; a strict investigation of the cerebro-spinal system must be instituted, and some other sign of lesion of that system will probably be discovered, in which case the treatment must consist in that which the general affection indicates, together with the employment of some local appliances suited to protect the patient

from the disagreeable results of his infirmity, such as a well-adapted urinal. Where incontinence results, as occasionally happens, from mere functional derangement, caused by debility from excesses, the cure will be effected by any means of a tonic character which can restore normal tone to the spinal system. For this object the preparations of steel and zinc, of strychnia, together with quinine and other vegetable bitters, are of value. Nutritious diet, cold sea-bathing, and abstinence from the causes of debility previously acting, form also a part of the treatment for these cases. The local alteration of structure, which does occasionally give rise to the incontinence just described, is a form of enlargement of the prostate, in which the posterior portion, commonly called "third lobe," is much hypertrophied, and projects forward in the manner of a wedge between the two lateral lobes, so as to open out the neck of the bladder and render it constantly patent; instead of projecting backwards into the cavity, as almost invariably happens, and forming a species of valve which prevents the outward flow of urine. The former condition permits the bladder to remain constantly empty, and the organ becomes small in capacity. The latter maintains it constantly filled with stagnant urine, unless the catheter be employed to remove it, and produces a dilated and capacious bladder. The treatment of the former condition consists mainly in providing a urinal; nothing in that stage can be done to modify the form or condition of the enlarged prostate, beyond that which is effected in preserving as good a state of the general health as circumstances admit.

Habitual engorgement of bladder, and overflow of urine.—These terms more correctly describe the conditions met with in the majority of cases in which urine passes involuntarily than that of "paralysis," so commonly used, and already referred to at length. Urethral obstruction from enlarged prostate, or stricture, having existed for a certain period of time, the bladder becomes unable to contract with sufficient force or continuance to overcome the obstacle and empty itself; so that a certain portion of the urine always remains after every act of micturition. This failure of the bladder to contract fully, when once established, becomes gradually more marked; the remaining quantity of urine becomes larger; the viscus is habitually engorged with fluid, its coats are thinned, distended, and atonied, its neck is dilated, and as this permits a portion to run off irrespective of the patient's will, brief temporary relief is afforded. This overflow occurs first during sleep, and subsequently from pressure of the abdominal muscles when any efforts inducing their contraction are made. Unless this state of things is remedied by proper treatment, the result is, sooner or later, chronic inflammation of the bladder, with a tendency to spread upwards to the ureters and kidneys.

The treatment of engorgement and overflow consists in emptying the bladder from once to three or four times in the twenty-four hours, according to the necessities of the case, and in using those remedies which the amount of chronic cystitis, almost always present to some extent, indicates to be necessary (see Chronic Cystitis, p. 758).

Retention of urine (see Stricture).

THE PROSTATE.

Malformations.—There are no special malformations to be noted here, except such as are involved in the condition called "extroversion of the bladder," which see (p. 754).

Injuries (see vol. i. p. 830).

Inflammation of the prostate (*prostatitis*), } acute, chronic.
Abscess of the prostate.
" periprostatic.
Hypertrophy and simple tumors.
Atrophy.
Malignant disease.
Tubercle.
Cysts.

Acute inflammation of the prostate.—This affection rarely exists alone, but is generally associated with inflammation either of the urethra or of the bladder. It may be secondary to cystitis, and often is so; but it more frequently owes its origin to gonorrhœal inflammation, which has extended unchecked to the prostate, and it may be to the bladder also. Sometimes, however, it happens apparently as a purely idiopathic occurrence, and not by extension through continuity of tissue. This idiopathic inflammation, excepting the cases produced by violence, as by instruments, etc., is probably extremely rare.

Causes.—These are: the pre-existence of acute inflammation of the urethra from any cause, but especially the gonorrhœal; stricture of the urethra in an aggravated form, giving rise to inflammation of all the parts posterior to it; the application to the prostate of strong injections, cauterization, the passing of sounds, and mechanical violence of various kinds; inflammation of the bladder, and calculi. Cold and damp to the perineum will give rise to it, perhaps most frequently in gouty and rheumatic subjects. Alcoholic drinks may induce prostatic inflamma-

tion, urethritis already existing, but only on this condition. Inordinate sexual excitement, under the last-named circumstances, is also an undoubted cause.

Symptoms.—At first, a sensation of weight and fulness about the rectum and perineum is experienced, with some pain and uneasiness at the neck of the bladder. The patient wants to pass water more frequently, and does so with much pain, especially at the close of the act. These symptoms increase; the pain becomes severe, shooting and throbbing, and almost continuous; a sense of great tension is experienced, and the anus and perineum are tender when pressed. Pain in the back and loins, and often in the thighs, is complained of. Movements of the body become painful, as does also the sitting position. The act of relieving the bowels at stool produces considerable distress; and a finger introduced into the rectum encounters opposition; the anterior wall of the bowel is prominent, hard, and hot, and the outline of the prostate may be traced, much larger than in the natural state. An attack of piles may be induced, the close contiguity of the hemorrhoidal and prostatic veins favoring this result. Should a catheter be passed, the patient complains of excessive pain when the instrument reaches the prostatic part of the urethra. At a later stage, if suppuration has taken place, the rectal swelling becomes softer. Micturition is often difficult, and may even be impossible, total retention occurring from the obstruction produced by the swollen prostate. General fever accompanies these symptoms, commencing with rigors, and manifesting itself by all the usual signs during the acute stage of the disease. Pus usually appears in the urine after a few days, and if there has been abscess, a large quantity usually escapes suddenly by the urethra, with great relief to the patient.

Treatment.—In general cases antiphlogistic regimen and diet should be observed. There is seldom reason to bleed from the arm, none to give mercury, except as a purge; but a little antimony and full doses of alkali should be taken, such as the bicarbonate or acetate of potash. The bowels should be freely opened at the outset, and a gentle action upon them maintained afterwards. Local bleeding usually gives more relief at the outset than anything else. From ten to twenty leeches should be applied to the perineum and around the anus: or a cupping to six or eight ounces may be performed. Then a hot hip-bath should be taken, followed by a large poultice on the perineum, and the patient be wrapt up warmly in bed. The hip-bath may be repeated with advantage in the course of the treatment, but should not be used for more than ten minutes at a time, as a rule. If retention of urine occurs, and does not give way at once to hot fomentations and a full dose of opium, a medium-sized gum elastic catheter should be passed, and the bladder relieved. The instrument may generally be withdrawn at once, and is to be used again if necessary (see Retention of Urine).

In the course of a few days the severe symptoms generally subside, often, however, not without the occurrence of occasional relapses. These are mostly attributable to some indulgence on the part of the patient, either in the use of stimulants, exercise, or erotic excitement. When convalescence is established, the prostate still remains much enlarged and hard, and the stream of urine is not propelled with the natural amount of force.

Chronic inflammation.—In this condition the prostate is sometimes enlarged, but not invariably; when occurring as a sequel to the acute attack, perhaps it always is so. The symptoms are: diminished force in propelling the urine; usually also some gleety discharge; the urine is cloudy, and deposits more or less pus on standing, and after passing it, a drop or two of blood may follow. There are weight and dull pain in the perineum and about the anus; pain also in passing water and in sexual intercourse; and sometimes, but not as a rule, frequent and debilitating nocturnal emissions. The bladder is irritable, and all the symptoms are generally aggravated by much exercise and by errors in diet.

Treatment.—One of the best means is counter-irritation of the perineum by nitrate of silver or acetum lyttæ, maintained for some weeks, and the surface dressed with simple ointment. Tonics and good diet, with attention to the digestive organs, are almost always indicated; these latter being in fair condition, iron is mostly beneficial; and as the bowels should in these cases not be constipated, the iron should be combined, when necessary, with some mild laxative. When nocturnal emissions are frequent, and especially if they occur without any consciousness whatever on the part of the patient, the application of a solution of nitrate of silver, from ten to thirty grains to the ounce, to the prostatic part of the urethra, is one of the best means of treatment. To be successful, an efficient instrument is absolutely necessary, as well as care in injecting the fluid at the right spot: three or four applications may be requisite. Let it be remarked, that we are by no means to infer the existence of chronic prostatitis because the patient is subject to frequent seminal emissions. These occur frequently from altogether

different causes, which, as they have no necessary connection with diseases of the prostate, need not be further considered here.

When enlargement only remains after acute inflammation, the iodide and bromide of potassium should be given for a considerable period of time. Conjoined with or following this treatment, a course of tonics, steel and quinine, with seabathing and generous diet, often effects a great improvement and completes the cure.

Abscess of prostate.—Acute inflammation, when neglected, or occurring in a naturally weak or delicate constitution, may result in suppuration of the organ. This occurrence may be suspected when after the first week or two the acute symptoms do not subside, when the pain and difficulty of micturition and defecation increase, if rigors occur, and the patient is very restless and feverish, complaining of tension and pulsation in the perineum or neck of the bladder. Fluctuation may be felt per rectum; or pressure in the perineum may reveal tenderness and fulness there. The natural course of abscess in the substance of the prostate is generally evacuation by the urethra. Occasionally it issues by the rectum, and this is perhaps as favorable, generally speaking, as through the urethra. It may be followed by a troublesome urethro-rectal fistula; but this is rare. Generally the opening of the prostatic abscess into the urethra soon closes; but if this does not take place, the cavity may long remain open, and become a receptacle for urine, giving rise to fresh abscesses in the vicinity.

In treating a case presenting the symptoms described, we should watch for any evidence which may exist of matter forming in the perineum; and if so, an incision should be at once made boldly in the median line, so as to evacuate it. If successful, the patient will be greatly benefited; but if no pus is encountered, no harm results, but the relief of pain and of tension is probably effected. Occasionally puncture of the abscess has been accomplished in the rectum, when fluctuation has been distinctly felt there.

The discharge of matter from an acute abscess of the prostate is sometimes followed by long-continued suppuration. Chronic abscess may arise here spontaneously, though not very frequently; generally resulting from confirmed or neglected stricture of the urethra. When this has occurred, and the matter has been discharged into the urethra, it sometimes happens that the cavity enlarges, urine makes its way into it, fresh irritation is maintained, and much of the prostate is destroyed; its capsule becoming little more than the sac of a pus-secreting cavity. Sometimes the abscess is limited to one side or lobe only, and sometimes the collections are two or three in number; generally speaking, however, the result found after death is that described. This condition is always one of serious import, and its existence is often not suspected during life. There are present the symptoms of chronic cystitis, emaciation, often hectic; and a highly tonic and soothing regimen is usually indicated. Injections of nitrate of silver, of half or one grain to the ounce, are sometimes useful; but no local interference is desirable which gives much pain, or even temporarily aggravates the symptoms.

Abscesses supposed to be prostatic have not unfrequently turned out to be situated external to the prostate, and not within the envelope of the organ. Such are termed periprostatic. They arise much in the same manner as prostatic abscesses, but are of less serious import than those situated within the capsule of the prostate itself. The treatment requires early incision, and does not differ in other particulars from that already described for prostatic abscess, properly so called.

The organic enlargement of the prostate of advanced age (hypertrophy). This common affection very seldom occurs before sixty years of age; I have never seen or heard of a true example of it before the age of fifty-four years. Chronic inflammatory enlargements may occur at any age after puberty; but the disease now under consideration is wholly distinct, both in nature and by causal relations, from such or any other inflammatory state. It has been said to be the common inheritance of old age, but it is, on the contrary, a complaint which a very large majority of elderly men escape. With the view of ascertaining the relative frequency of its occurrence, so far as such a number of observations can be regarded as indicating it, I dissected out with great care the prostate in forty-three elderly individuals, the results of which inquiry are presented in the following summary: Appreciable enlargement existed at the rate of 32 per cent.; notable enlargement, causing symptoms during life, at the rate of 12 per cent. The oldest individuals of the series were among the unaffected; including 1 at ninety, 1 at eighty-five, and 2 at seventy-nine years. Subsequent more extended researches by Dr. Messer and myself have but confirmed these results.

The enlargement consists mainly of an over-development of certain tissues which enter into the normal structure of the

organ itself. These tissues consist, first, of unstriped muscular fibre and the connective tissue always associated; and they form at least three-fourths of the prostatic body: secondly, interspersed among this structure are numerous branching glandular tubes and crypts with their accompanying ducts.

Enlargement, or hypertrophy as it is commonly termed, may be determined by an abnormal production of the first-named elements alone, or with some of the glandular tissue interspersed; and this latter may be fully or imperfectly developed. The two lateral lobes of the prostate may in this manner be increased to four or six times their natural weight and bulk; or an outgrowth may take place from the central part of the organ, in a backward direction, towards the cavity of the bladder, as a more or less rounded or pyriform tumor of prostatic tissue, and constituting what is frequently, but not very correctly, called the enlarged "third lobe;" and this form is one of those most commonly met with. Generally, however, every part of the organ partakes more or less in the enlargement.

Fig. 436.

An example of greatly enlarged prostate, the increase in size being mainly due to the fibrous tumors described; opposite *a*, *b*, and *c*.

Again, while the tissues thus described may be generally over-developed throughout the entire prostate, it is very common to find independent, or almost independent, and isolated tumors of the same material embedded within the prostatic structure proper. On making a section with a sharp knife of a prostate so affected, these small rounded bodies are easily divided, and the portions may be removed by the finger-nail. They are usually made up of very compact tissue, like that of the prostate itself, but generally with less of the glandular element, and that, almost always, presenting a defective development. Sometimes they are completely isolated by a limiting fibrous cyst. The presence of these small tumors is extremely common in the enlarged prostate, as well as in the healthy organ in advanced life, and they seem to bear a relation to the containing organ somewhat similar to that which the uterine fibrous tumors bear to the uterus. In both cases they are composed mainly of unstriped muscular tissue, and exhibit other points of analogy in their nature and history.

The most important result of enlargement is obstruction to the flow of urine. Its first effect on the prostatic urethra is increase, sometimes considerable, of its antero-posterior diameter; there is also diminution of its lateral or transverse diameter, the canal becoming a narrow passage, instead of one which, when distended, is of about equal diameter in every direction. The length of the prostatic urethra is also materially increased, and it is often tortuous also. In some preparations which I have examined, the urethra has measured four inches from the orifice of the bladder to the membranous portion, instead of one inch and a half, which is the normal length.

The natural direction also deviates: where there is enlargement of the median portion or "third lobe" the urethra suddenly rises, producing an angular curvature in the place of a nearly straight line; so that a complete step has sometimes to be surmounted at the neck of the bladder before an instrument will enter the cavity. When, with this development of the median portion, there is much enlargement of either lateral lobe, the lateral direction of the canal is also changed. Thus if the right lobe predominates, there will be a lateral curve of the urethra, the convexity of which is presented to the left, and *vice versâ*.

The next deviations are those in the form of the internal meatus, or vesico-urethral orifice. When the median portion predominates, this orifice has a crescentic form, the convexity of which is directed upwards. When the right lobe considerably exceeds in size the left, the crescent has its convexity to the left side; and so on. In some preparations, where two or more irregularly-enlarged lobes are combined, the orifice is much distorted, presenting a tortuous outline. Sometimes it is overlapped by an outgrowth from the median portion in the form of a valve. In this case, which is not common, the

valvular portion appears to be forced against the neck of the bladder by the effort of micturition, and the obstruction rendered still more complete.

Fig. 437.

Bladder, symphysis pubis, and enormously enlarged prostate; a portion is removed from the left wall of the bladder, to show the vertical ascent of the urethra as it enters the bladder.

The size and weight attained by hypertrophied prostates are sometimes remarkable. A prostate measuring two inches

Fig. 438.

Hypertrophy of the prostate affecting equally the lateral lobes and median portion; a typical example of the usual condition in a moderately advanced case.

in a transverse direction, and one inch in thickness from before backwards, or which weighs an ounce, must be considered hypertrophied. On the other hand, a transverse measurement of three inches is not uncommon. I have seen one exceeding four inches and a quarter; but such a degree of enlargement is extremely rare. The weight has been known to reach twelve ounces. In malignant disease even these limits are exceeded.

The consistence of the organ varies, being sometimes firmer and harder in texture, at others a little looser and softer than in the natural condition. It usually presents the former character when numerous fibrous tumors are embedded in its substance.

Symptoms.— In the earliest stage of chronic enlargement of the prostate there is nothing to attract the attention of the patient, as it is probable that a considerable period is passed between the actual commencement of enlargement and the occurrence of any marked symptom. One of the earliest signs generally observable is diminution in the force with which the urine is ejected, and the lapse of time which occurs before a stream is established. The size of this is not necessarily much smaller than it was in health, but it cannot be projected so far by the ordinary amount of effort. The desire to pass water becomes more frequent than natural, and the relief afforded by the act of micturition is less complete. On rising in the morning, when the bladder has become distended during sleep, the want occurs again in a few minutes, especially after the first effort; and in course of time sleep is much disturbed by calls to pass water. A sense of weight, fulness, and uneasiness about the perineum and rectum is felt, which the patient soon refers to the neck of the bladder. As the expulsive efforts to pass water become more frequent, irritation of the rectum increases, the contents of the bowel are more frequently passed, from inability on the part of the patient to prevent the act of defecation accompanying that of micturition; and tenesmus, protrusion of the mucous membrane or prolapsus, and hemorrhoidal swellings, are apt to result. Much stress has been laid by some writers, following J. L. Petit, on the appearance of flattened stools as an indication of enlarged prostate, but certainly without sufficient grounds. In some cases the motions may be passed in the form described; but this is caused by the action of the sphincter ani, and not by the prostate. If the complaint advances unchecked, the symptoms of chronic cystitis appear, and pains also sometimes in the penis and testicles. Occasionally, some muco-purulent discharge from the urethra is observed; this varies with circumstances, sometimes appearing after ex-

posure to cold or damp, or with an attack of retention; while it may happen also that the irritation involves the testicles, which become tender and swollen. Vascular excitement of the penis, producing frequent erections, is also at times a concomitant symptom. As the complaint makes progress, relief to the bladder in micturition becomes less complete, since the enlargement gradually closes the neck or urethro-vesical outlet, and the bladder is never emptied, a certain portion of its contents only being expelled at each act of micturition. These difficulties, if unrelieved, inevitably increase: the capacity of the bladder yielding to the constantly-augmenting pressure upon it. Hence in time the organ remains habitually filled, and the surplus only flows off at each act of micturition. At night, when voluntary control is suspended by sleep, urine drains away, to the great discomfort of the patient. This condition is generally described as "incontinence," but a better term is "overflow," as aptly indicating a condition in which the bladder *retains too much*. A sign which should be looked for in such cases is the existence of dulness on percussion above the pubes, and the degree, if present, to which it extends; it is sometimes found as high as the umbilicus, although more frequently to the extent of only three or four fingers' breadth above the pubes.

As the complaint advances, the patient's health deteriorates, and he is the subject of frequent febrile disturbances; while slight irregularities, or exposure to adverse circumstances, produce extreme distress from the severity of the symptoms occasioned. Attacks of complete retention are impending on these occasions, and the functions of the kidneys become impaired through the long-continued impediment to the discharge of their secretion. A little hemorrhage is not uncommon, and sometimes relieves congestion: it may occur after exposure to cold, sexual excitement, or other circumstances which tend to produce a vascular determination to the pelvic viscera.

The characters presented by the urine are such as depend on decomposition of some of its constituents from abnormal retention, mixed with the products of chronic inflammation of the bladder. More or less of mucous deposit slowly falls to the lower part of the vessel, and a thin pellicle forms on the surface, which is sometimes iridescent. In later stages the mucus increases in quantity, and appears as the glairy, tenacious, slimy, adhesive matter so well known to be associated with chronic inflammation of the bladder. This sometimes exhibits traces of phosphatic matter, in masses of soft consistence and whitish color. When the mucus has subsided, there is sometimes deposited upon it an opaque creamy-looking layer of pus mixed with crystals of the triple phosphate in varying quantity. In any stage of the complaint, the urine may be darkened in color from admixture with blood.

The chemical reaction of the secretion is at first neutral, then alkaline in various degrees of intensity. The odor is pungent, ammoniacal, often fetid, sometimes extremely so. These characters are influenced to some extent by the quantity passed, which often varies considerably in the same patient from day to day; the measure being sometimes below, but more generally much above, the natural or healthy standard.

As a result of long-continued disorder in the urinary apparatus, and of the changes in the urine itself, which have been thus described, it is not surprising that the formation of calculus sometimes takes place. Its presence will be suspected if there is much pain about the neck of the bladder at or following the act of micturition; if the pain at the end of the penis is unusually severe, and if the blood and pus are very frequently observed, and especially if fragments of calculous matter have from time to time been passed. But the existence of calculus is often wholly masked by the prostatic disease, because the conformation which the neck of the bladder assumes in this affection tends to prevent the most distinctive symptoms of stone; inasmuch as the foreign body is less liable to be engaged in the vesical neck, but lies back deeply behind the enlarged prostate.

It not unfrequently happens that symptoms of enlargement exist long before the real cause is suspected; the frequency of micturition suggesting that there is undue freedom rather than obstruction to the act. The real malady is unsuspected, and the treatment is directed only to those symptoms which have been productive of most discomfort or anxiety to the patient; to some febrile condition, it may be, resulting from the hidden cause. The march of events, however, must ultimately throw suspicion on the state of the bladder: a catheter is passed, and, greatly to the astonishment of the patient, some thirty or forty ounces of urine, or even a much larger quantity, may be drawn off, notwithstanding that the act of micturition has been just performed. And it occasionally happens, during the prevalence of such a state, that some unaccustomed error in diet, or exposure to cold and damp, suddenly produces congestion of the prostate, and complete retention, and so discovers the existence of the affection for the first time.

The last stage of unrelieved disease is

indicated more by the signs of a gradual decline of the powers of life than by those of advancing obstruction; although sometimes the final symptoms are those of rapid depression, after sloughing or ulceration of the bladder, and repeated hemorrhage, or from great discharge of pus from its cavity; rarely there is uræmic poisoning from failure of the eliminating function of the kidney.

Diagnosis.—The test which is chiefly depended on by the surgeon is digital examination by the rectum. For this purpose, the patient should lie on his back upon a couch, the surgeon standing on the left-hand side, so that the forefinger of his own left hand may be employed in the rectum, while the right hand is free to use a catheter if required, since by concerted movements of that instrument in the urethra, and of the finger in the rectum, more accurate information may sometimes be obtained than by either exploration conducted separately. The patient's knees being drawn up and separated a little from each other, the finger should be made to glide slowly through the sphincter, and when introduced as far as possible, so that two phalanges are free to move in the bowel, the limits of the prostate may be defined.

If familiar with the normal conditions of the organ, its deviations will easily be recognized by a methodical examination. We may first observe its size and form; thus, respecting enlargement, is it general or partial? affecting one or both lobes? and to what extent? It is so prominent sometimes that the tip of the finger encounters the swelling the moment it enters the rectum, and has to be depressed very considerably before it can be carried beneath the tumid organ. Instead of finding the yielding coats of the bladder in the middle line, when the finger is carried up to its fullest extent, an increasing fulness and firmness may be encountered, due to an enlargement or outgrowth from the median portion. The form of the enlargement may not be uniform but irregular in outline.

Next, we observe whether the tumor is soft, hard, or unequally so in places; whether there is fluid in it; and whether we can appreciate fluctuation distinctly beyond it; an important consideration in a case of retention which may require the trocar. We observe also the degree and locality of tenderness on pressure. If inflammation is present, the pain will be extreme, and the mere introduction of the finger will be very distressing to the patient; in this case, heat and tension will be remarked also.

Lastly, supposing the catheter to have been previously introduced, we may, while holding it in the right hand, and communicating to it gentle movements downwards, gain an approximative idea as to the thickness of the tissue which intervenes between it and the finger in the bowel, and as to the situation and direction of the instrument, etc., in the event of there being difficulty in introducing it.

Having learned relatively to these different points all that can be attained through the rectum, the urethra is to be explored. A full-sized catheter, of the form ordinarily employed by the surgeon, should be first used, because any phenomena presented differing from those observed when the prostate is healthy are then at once made apparent. If by examination through the bowel no variation is found in regard of size, and the urine flows when the catheter has traversed not more than the ordinary distance, say from six and a half to eight inches, while the handle of the instrument itself has not required more than the ordinary amount of depression in order that its point may enter the bladder, we may be satisfied that prostatic enlargement does not exist; and we must seek for another cause of the symptoms complained of. But if the catheter has passed easily, say for nine or ten inches, and still no urine flows; and if, in addition, while following its course, the handle has become more than usually depressed, there will be little doubt in respect of the existence of prostatic enlargement. The ordinary catheter being inadequate to reach the bladder, a prostatic catheter, which measures from two to four inches longer, and possesses a larger curve than the ordinary catheter, may be employed. If it passes readily, the increased length of the urethra is easily ascertained, and the direction of the prostatic canal is calculated from the position of the shaft when the point enters the bladder. In some few cases, while the beak passes through the prostatic part of the urethra, the handle will be distinctly deflected to the right or left, from which fact, if verified by two or three trials, a greater degree of enlargement may be suspected to exist on the side *towards* which the handle turns.

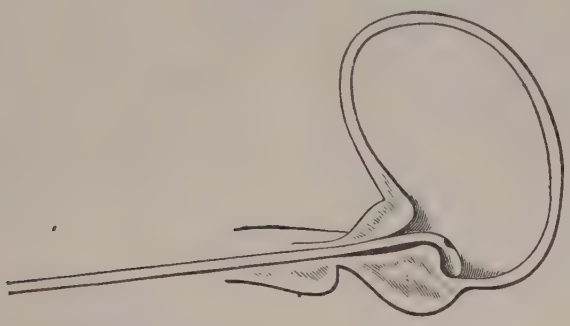
For the purposes of accurate diagnosis, we shall employ with advantage an instrument of a different form, viz., an exploring sound with a very short curve at its extremity, or possessing a beak rather than a curve, which is shorter and more angular than that of the ordinary catheter. By its means not only can every part of the bladder be searched for calculus, but information respecting the form and degree of obstruction at its neck can also be acquired: see fig. 439. After the bladder has been traversed, the instrument should be gently withdrawn

until the beak lies just within the urethro-vesical orifice, when, by turning it round to the right and left, the natural condition, if it exist, of that part can be ascertained; or, on the other hand, the presence of tumor or of stone, the depth of the fossa behind the prostate, and other relative points, can be determined. A light, delicate, and practised hand is necessary in its use.

This portion of the subject may be appropriately closed with a few remarks on the diagnosis of prostatic enlargement from stricture of the urethra, vesical calculus, tumor of the bladder, simple atony or inertia of the coats of the bladder, and paralysis.

In stricture of the urethra, the stream of urine is invariably small, in a confirmed case extremely so; in the prostatic

Fig. 439.



The exploring sound, with short angular beak, for defining tumor, or discovering calculus: in this case represented in a bladder with enlarged prostate.

affection, though diminished in force, it is much less so in volume than in the previous case. The use of a full-sized sound, however, marks the distinction clearly. In stricture, obstruction is encountered almost invariably before six inches of the instrument have disappeared, always before it arrives at the prostatic urethra. In enlarged prostate, obstruction is not encountered until seven, eight, or nine inches have passed, and not necessarily then, for, provided that the instrument be sufficiently long, it may pass into the bladder; but the handle has to be depressed between the patient's legs in a manner not required in the normal state. Lastly, stricture almost invariably makes its appearance before middle life, prostatic hypertrophy not until that period is passed.

In regard of calculus, while many of the symptoms are common to both complaints, the occurrence of sudden cessation of the stream of urine, of severe pain at the close of micturition, the exacerbation of symptoms, especially of pain and the appearance of a little blood after exercise, may be looked upon as strongly indicating the presence of stone in the bladder. But it may exist in the absence of most of these symptoms, the two first-named especially, from the circumstance that the calculus is usually situated behind the enlarged prostate, and does not approach the more sensitive region of the internal meatus. The fact of small quantities of florid and unmixed blood being occasionally passed after exercise, more closely approaches in value to a pathognomonic sign than any other. Then the frequency of making water is greater at night in the prostatic affection, but greater during the day when the cause is calculus. A persistent discharge of muco-pus streaked with blood should arouse suspicion. The use of the sound, however, can alone clear up the case satisfactorily.

The existence of non-prostatic tumor of the bladder is less easily affirmed. Compared with prostatic enlargement, there is much more pain in the introduction of instruments, the urine is frequently or generally mixed with sanious discharge and flocculi, to which sabulous matter is often seen adhering. Examination of these under the microscope may reveal the peculiar structure of villous growth; or may demonstrate that these flocculent matters consist of organized structures, not of inorganic materials, a fact possessing some significance.

Simple uncomplicated chronic cystitis, with catarrh, is by no means a common affection. Such symptoms are almost invariably due to the presence of a foreign body, to some form of obstruction, or to paralysis, or atony, depriving the patient of the power of expelling the contents of his bladder, a condition which is tantamount to obstruction. We may rely upon it, that in most of the obscurer cases there is a material cause, frequently cal-

culus; the presence of which needs a more than ordinarily searching examination to verify.

Single or repeated acts of voluntary over-retention of urine are sometimes followed by atony or inertia of the muscular parietes of the bladder, and a state of chronic retention follows from their consequent inability to expel the vesical contents. The condition resulting resembles much the retention produced by enlarged prostate, and requires frequent relief by the catheter in the same way, at least for a time. Here the absence of physical signs, the suddenness of the attack, its connection with a cause generally recognized by the patient, and the diminished power of discharging the urine *after a catheter has been placed in the bladder*, especially when he is recumbent, are sufficient to distinguish this affection. Particular attention should be paid to the last-named point. In enlarged prostate, the urine often flows with considerable force when the influence of the obstruction is removed by the introduction of a catheter, and the current can be accelerated materially by the will of the patient, unless there be atony also, as there may be from undue distension; the atony, however, is not generally considerable, except in long-neglected cases. But when the cause of retained urine is not obstruction, but atony of the bladder, the urine barely flows from the catheter, and is not propelled, nor is it so much influenced by any efforts of the patient.

Lastly, there is paralysis of the bladder; a condition in which its nervous supply is either impaired or destroyed. It is almost always associated with a similar condition of the lower extremities, and this may result either from disease or injury of the encephalon or spinal cord. There can be, therefore, little doubt respecting its presence; and when it does exist, the indication which catheterism presents is characteristic. An instrument being introduced, the urine is propelled by the weight of the parts around, the will of the patient exerting no influence upon its flow unless the abdominal muscles should be in a normal condition, as in cases of injury (rare) occurring to the spinal cord between the sources of nervous supply to those muscles and to the bladder, in which case a slight influence is perceptible. Otherwise no impulse is noticeable, except through the agency of acts unassociated with micturition; such as deep inspiration, coughing, sneezing and the like, by which a momentary pressure is communicated to the paralyzed bladder, and the stream is temporarily accelerated.

Treatment may be regarded under three heads.

1. Treatment for the purpose of obviating the results of obstruction caused by hypertrophied prostate.

The fact being discovered that a certain quantity of urine is habitually retained in the bladder, however frequently or forcibly the efforts to evacuate it have been made, the first thing is to ensure the complete removal of the urine from the viscus at least once a day. It may be very desirable to do this twice, or even three or more times, daily, the necessity depending upon the degree of obstruction, and the consequent amount of residual urine. And if the power of urinating is almost or quite lost, it will be necessary to employ the catheter as often as a decided want to micturate is felt. There are certain modifying circumstances which must be taken into account; such as the facilities which exist for passing instruments, and the condition of the urethra itself. If the patient possesses the ability to pass a catheter easily for himself—and it is very rare that he cannot attain it by tuition and practice—he complies with the demands of his case. He should be made to understand that, having his own sensations to guide him, he may soon attain considerable dexterity in the management of an instrument in his own urethra. But if this be in an extremely irritable state, which is aggravated by the frequent use of the catheter, however carefully it may be introduced, it is necessary to consider carefully the relative necessities of the urethra and the bladder, and some compromise must be made between them. In most cases, the removal of the urine night and morning suffices to maintain the reservoir in a tolerably sound and healthy condition, and it is extremely undesirable to resort to artificial aid with greater frequency than is absolutely necessary to accomplish this. For the use of the patient himself, and generally for the surgeon, flexible instruments are, in the majority of cases, the better and safer kind. When silver instruments are necessary, the curves often require to be larger, and more strongly marked than those ordinarily employed. Three good forms are shown in fig. 442. The fourth catheter is a flexible one, mounted on a well-curved stylet to preserve it for use in its proper form.

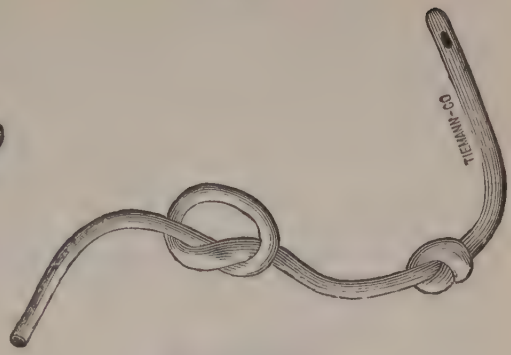
[The Mercier catheter (fig. 440) requires mention here. It is a very valuable instrument in many cases, especially where there is much median prostatic hypertrophy. Patients sometimes prefer this form to all others for self-catheterization.

Probably the best instrument of all is the soft rubber catheter, if the patient can use it without a guide. The so-called velvet-eyed soft rubber instrument of American make is stiffer, and has a better

Fig. 440.

The Mercier catheter.

Fig. 441.



Soft rubber catheter.

eye than the English instrument (fig. 441). If a guide has to be used with this catheter, it is not suitable for self-catheterization.]

When the necessity for a catheter is very frequent, some have advocated the plan of permitting a catheter to remain in the bladder for days together. As a

Fig. 442.

a, rubber catheter with properly curved stylet; *b*, *c*, *d*, silver instruments.

rule, this is not desirable, since irritation and even ulceration may be soon produced by the instrument. Where, however, great frequency in making water exists, and ease and sleep are found to be promoted by the plan, it should be adopted for twelve hours or so at a time; as during the night, for example. In this manner it may be extremely useful. But in circumstances of urinary retention, which has been relieved with difficulty by the catheter, we may be justified in permit-

ting the catheter to remain in the canal for a considerable period. The vulcanized India-rubber catheter has for years been recognized in this country as the easiest for the patient, and the least liable to be encrusted with phosphates when tied in for these cases. It may be introduced without a stylet sometimes, but owing to its extreme flexibility often requires to be mounted on a well-curved one, which is then withdrawn and the tube left in place. Usually it is easy to retain it there by passing a piece of soft string or bobbin around the penis behind the glans, attached to the neck of the catheter. If there is a tendency to slip out, it is usually quite overcome by applying a piece of soft adhesive plaster around the whole of the penis, and so covering the retaining string. Mr. Holt appears to have experienced some difficulty in keeping the vulcanized catheter in its place, and has therefore suggested the attachment of "wings" to its inner end to prevent its ejection by the bladder. The circumstances are not frequent in which the vulcanized instrument is ever necessary, still less frequent is it to experience much difficulty in retaining it, in which circumstances, if they arise, the winged catheter may perhaps be tried with advantage.[1]

The consequences of enlarged prostate already alluded to, viz., the increasing retention of urine and habitual distension of the bladder, which accrue from not completely emptying it daily, form only a portion, although a very important one, of the evils which can be obviated by the habitual use of the catheter. It is impossible to overrate the benefits arising to the patient from its use; and the responsibility which is incurred by overlooking it should be ever present to the surgeon's mind in dealing with any signs of irritability of bladder, or incompetence to retain perfectly the urine by patients in advanced years. [The habitual use of the catheter generally involves the necessity of, at least occasional, ablution of the bladder, whether signs of mild chronic cystitis are present or not. It is not well to wait for anything further than the appearance of a moderate amount of pus or an extra quantity of mucus in the urine. The presence of either during the habitual use of the catheter makes it more necessary for the patient to wash out his bladder daily than to wash his face.]

In relation to the treatment of chronic cystitis, catarrh, etc., arising as they so frequently do in connection with hypertrophied prostate, see the sections thus headed, pp. 758, 759.

2. The general treatment of enlarged prostate.

[1] Lancet, May 14, 1870.

It is of great importance to maintain all the functions of the body in healthy action, in treating patients who thus suffer. Slight derangements in other parts of the system are very prone to augment the urinary symptoms. A simple catarrh, a fit of indigestion, or unrelieved constipation, are very apt to produce increased obstruction or greater irritability of the bladder.

All that tends to derange the stomach and bowels, to tax unduly the digestive powers, or to over-excite the circulation, must be avoided.

The clothing and the habits should be such as encourage and maintain a due action of the skin. Damp must be sedulously avoided, or removed after exposure, especially from the feet, without delay: the lower limbs should be kept habitually dry and warm; a habit of the first importance, as freedom of circulation and healthy vascular action here is one safeguard against the recurrence of congestion in the organ.

The question of exercise is one of importance. The subject of enlarged prostate must not be encouraged to believe himself too much an invalid, but must exert his physical powers, as far as they exist, in daily exercise in the open air, of which walking is the best form. Riding is generally out of the question; the movement of trotting is undoubtedly prejudicial, and bleeding is often caused both by it and by a long drive over rough roads, or, indeed, after a long railway journey; and, at the same time, increased difficulty in micturition. To assist in producing a healthy and natural state of mind, occupation of a cheerful character, suited to engross the thoughts and energies of the patient, should be found, if possible.

3. Special treatment of the hypertrophy itself.

Although many agents have been administered for the purpose, all medical treatment has been hitherto marked by inefficiency, as to any power exhibited in effecting a reduction in the size of the enlarged organ. Hemlock, mercury, and hydrochlorate of ammonia have all been largely tried, and a certain utility has been claimed for them; but it must be confessed that there exists very little ground for regarding them as efficacious against senile hypertrophy. Iodine, however, at one time seemed to promise more success. It was formerly much employed by Mr. Stafford, who reported results of much greater value than others have since been able to obtain. His plan consisted in administering it by suppositories in the rectum, occasionally by the mouth, and in applying it to the urethral surface of the prostate in the form of a weak ointment; commencing with one

grain of the iodide of potassium to the drachm of simple cerate, and increasing it to ten or twenty grains to the drachm, sometimes adding to this a quantity of iodine.

Regarding this as one of the most powerful agents in accomplishing the removal of glandular enlargement, it was natural to infer that the hypertrophied prostate might also be favorably acted on either by iodine or bromine. Their influence over simple enlargements of the uterus is undoubted, and a certain analogy between prostatic and uterine enlargements has already been pointed out. But it must be confessed that after ample trials of these drugs there is no reason whatever to regard them as possessing any influence over the complaints in question. [Interstitial injections of iodine, although vaunted for a time in Germany, have failed to produce the desired effect; and the internal use of ergot, still ardently advocated in some high quarters, has absolutely failed to produce any benefit in my hands after a great number of trials.]

The influence of compression in retarding the progress of morbid growths and enlargements has been long recognized; attempts have therefore been made to extend its influence to the prostate. Physick, the American surgeon, first, afterwards Leroy d'Etiolles, Mercier, and others, have invented various appliances for effecting this purpose. Dilatation by water in expanding India-rubber tubes has been employed by myself. I cannot say, however, that any benefit is to be anticipated by any of these means.

Division of the obstructing portion at the neck of the bladder has been performed. Other operations have been also attempted for effecting a similar purpose, such as the excision or the crushing of a protruding portion; and even the ligaturing of a polypoid outgrowth. Respecting the division of an obstruction, bar-like in its form, elevated from the posterior border of the neck of the bladder, it is no doubt a proceeding to be accomplished without much difficulty, with the exercise of ordinary care. In most cases, although not invariably, the bar is a prostatic development, and when well marked may perhaps, in some cases, be incised with advantage, and without danger to the patient. Such was the opinion of the late Mr. Guthrie. I cannot say, however, that I have yet seen a case in which it has appeared at all advisable to practise such an operation. So much can be done by management, by maintaining the bladder in a healthy condition by means of the catheter, that the case must be rare indeed in which such an operative procedure is indicated.

In estimating these proposals, most English surgeons will be content with awaiting further experiences in the hands of those who have hitherto seen fit to adopt them. We can cherish little hope that any benefit will be conferred on the patient by such methods of accomplishing the ends proposed, even granting that no doubt existed as to the possibility of carrying them into execution.

Atrophy of the prostate.—The prostate is sometimes atrophied in old age, and occasionally it is so under certain circumstances in early adult life. It is but slightly developed in some malformations, and in constitutions in which the male sexual character is not strongly marked.

The normal weight being about four and a half drachms, it is occasionally found as low as two and a quarter, and not infrequently at three drachms, at ages between 60 and 80 years.

There are no special symptoms of atrophied prostate, nor is any special treatment indicated for patients who are the subjects of it.

Malignant disease of the prostate.—Malignant disease of the prostate is a rare affection; but it is probable that a few cases are lost sight of among the very large number assigned to senile hypertrophy. The course of malignant disease, when well marked, it is impossible, with ordinary care, not to diagnose from the last-named affection; but in those cases in which a malignant growth arises in a prostate previously the subject of senile enlargement, the cancerous character is sometimes overlooked.

Judging from the data at present existing, the prostate appears to be less commonly the seat of secondary than of primary deposit; the latter only will be treated of here, unless the contrary is indicated.

Malignant disease of the prostate is almost invariably encephaloid. After a close examination of all the cases reported, I adhere to the opinion expressed by Dr. Walshe in 1846, and resulting at that time from an examination of fewer facts than we now possess, viz., that "the evidence of the occurrence of true scirrhus of the prostate is defective."

Melanotic deposit is said to be occasionally found associated with encephaloid of the prostate. Its presence is reported in two cases; one at adult age, the other in childhood. It is not to be forgotten that interstitially-effused blood in a fungous growth may be mistaken for true melanotic deposit, which to the naked eye it sometimes resembles.

Malignant disease has at present been observed only in childhood and at advancing age. No authenticated cases are on record

between the ages of eight and forty-one. The duration of the disease, from the first appearance of symptoms to the fatal result, appears to vary from one and a half to five years in adults, and from three to nine months in children.

The symptoms of the malignant affection are those common to prostatic obstruction of any form, but generally declaring themselves with greater rapidity than in the cases of senile hypertrophy. Besides them, there are other and distinctive characters, such as more severe pain, often very intense; occasional, often frequent hemorrhages; and more or less constitutional cachexia. The pain is felt in the rectum, or in the region of the sacrum, and shooting down the thighs, either the anterior or posterior aspect.

Hemorrhage is a common occurrence both at an early and late period in the course of the disease, always appearing at one time or another, sometimes to an alarming extent. The blood is usually voided almost pure or unmixed, and frequently after some attempt to urinate, which has been attended with greater exertion than usual. Less commonly is the hemorrhage continuous for some time, as happens in villous tumor, for example.

The enlargement formed by the prostate itself, when examined by the rectum, is hard at first, and may or may not be irregular in outline or consistence. Softening may in the later stages be felt, but the patient's powers do not always sustain him to so late a period as that in which the growth either softens or fungates. Consequently, on examination after death, the prostate may be simply enlarged; or there may be breach of surface and protrusion of soft granulations; or there may be a loss of substance and a cavity, the last-named circumstance appearing to be rare. Frequently other organs are affected, but by no means invariably. But there are always diseased lymphatic glands adjacent, and sometimes the infection reaches more distant groups. The existence of such swellings in the course of the iliac vessels, and sometimes in the inguinal region, may frequently be verified by examination of the abdomen, and constitutes a valuable sign in relation to diagnosis.

The urine may be closely examined, in cases of a doubtful nature, for the presence of cells which may be regarded as malignant from inspection of their forms and constitution. A good deal of débris is seen in advanced cases, its presence indicating that the growth has fungated, and throws off portions of its tissue; and these will sometimes exhibit all the characters of a malignant growth elsewhere. It is not to be forgotten, however, that the urinary passages yield epithelium cells of all forms and sizes abundantly, and these, I suspect, are mistaken sometimes for the so-called "cancer-cell."

Regarding the general treatment of malignant disease of the prostate, nothing more can be suggested than applies to the complaint when occurring in any other part of the body. The treatment is palliative, and must be regulated according to the necessities which arise in the progress of the case.

Thus, accumulation of urine must be provided against at the smallest possible risk of irritating, much less of injuring, the part. If catheterism can be dispensed with altogether, so much the better. In no circumstances is it of more importance to be extremely gentle in the manipulation of instruments. The pain must be relieved by anodynes administered both by mouth and rectum. The addition of conium to opium, by enema or suppository, is often useful; and by the mouth belladonna is sometimes a valuable auxiliary in mitigating pain, given in doses of from one-fourth to three-fourths of a grain twice or three times a day. Hemorrhage must be treated on principles already illustrated (p. 752). The powers of life are to be supported by every means in our power. Nutritious food, both in solid and fluid form, with a due proportion of alcoholic stimulant, must be supplied in accordance with the wants of the patient.

Tubercle of the prostate.—The prostate is very rarely the seat of tubercular deposit, and when it is so, appears generally to be somewhat increased in size, until the later stages of complaint are reached, when, after suppuration and discharge, its volume may become smaller than natural.

At no period of the disease is the prostate affected alone, some other part of the genito-urinary tract being the primary seat of the affection. In most cases the deposit takes place first in the kidney; the organ next commonly affected, among the genito-urinary group, is the testicle. In fourteen cases collected by myself, tuberculosis of the kidney occurred in eleven, and of the testicles in six: in seven of these cases the lungs are stated to have been diseased, they were probably so in nearly all. It is difficult to isolate any special symptoms indicative of this affection. Undue frequency and pain in making water, occasionally blood in the urine, and at times signs of cystitis, are commonly experienced. The presence of pus in the urine, of occasional hematuria, of pains in the loins, perineum, and penis, give rise to suspicions of calculus, to be resolved sometimes only by a careful search; no foreign body being found, the

nutrition of the patient, his history, and the condition of the lungs and other viscera, will probably lead to a correct diagnosis.

Nothing need be said of the constitutional treatment of tubercular disease, and little in relation to the local manifestation in the prostate. Mechanical interference is to be avoided, and every kind of irritating application. If suppuration takes the form of external abscess, it must be treated as other perineal or ischio-rectal abscesses. But more commonly the discharge of purulent and tubercular matter takes place into the urethra. The improvement of the health, by all those numerous means which regulation of the diet, regimen, exercise, climate, and medicine enable us commonly to achieve in tubercular patients, constitutes almost the whole of the treatment to be employed in the affection, when involving the urinary or genital organs. The diagnosis once established, it is of great importance that the patient should be kept free from all instrumental treatment, which, in such cases, provokes irritation, and aggravates the disease, without conferring upon him any benefit whatever.

Cysts of the prostate.—It is not at all uncommon, in making sections of an enlarged prostate, to find cavities, of an irregular form, in its substance, not met with in the normal organ. These cavities have all the appearance of being dilated follicles of the glandular structure. Ducts are easily traced into them; and frequently numerous little dark concretions lie free within. I have seen from thirty to fifty of these minute bodies occupying a cavity about the size of a grain of wheat or of a small pea.

But larger concretions, that is of the size of pearl barley, small prostatic calculi, may occupy each a separate recess of its own; and on removing the foreign body, a spherical, thin, and smooth-walled cavity is displayed. Sometimes hundreds of such small cavities may be found in one prostate; but this is a very rare circumstance. The formation of these cavities, or cysts as they have been called, depends a good deal on the prior formation of concretions. At all events, the two occurrences are closely associated. We know too little of either the one or the other to affirm anything very confidently respecting the precise mode of their formation. Most probably the cavities are nothing more than enlarged follicles, dilated cæcal terminations of the glandular tubes. There are no isolated cysts in the prostate filled with fluids, having no communication with the secreting structures around, as in the kidney; no formation, indeed, which can be regarded as analogous to that which may be considered as the type of simple fluid cysts. Although, in conformity with the practice of other authors, I have referred to "cystic disease" of the prostate, the use of the term is scarcely warranted by the phenomena presented; and if retained, it must be held to signify a formation of a wholly different kind from that which is indicated by it in the breast or kidney.

The cavities referred to do not attain a sufficient size, nor, as far as we know, do they give rise to any symptom whatever to render a knowledge of their presence possible during life. Generally speaking, they are capable of holding not more than a few minims of fluid. In relation to practice, the diagnosis is unimportant, as no indication for treatment would be presented by the fact of their existence, were it ascertained.

The prostate is, after long-continued suppuration, sometimes converted into a kind of cyst or membranous bag; this condition can in no respect be regarded as a form of cystic disease. The organ has, in fact, disappeared, and its capsule forms part of the sac of an abscess which has replaced the normal structures.

It is doubtful if hydatid cysts have ever been met with in the prostate. Cases are on record in which retention of urine and distension of the bladder occurred as a result of a hydatid cyst *between the bladder and rectum*, near to the neck of the former; but in which the prostate was not affected except by pressure. Prostatic enlargement was very closely simulated certainly in some of them, and in two the prostatic catheter was employed under the belief of its existence. Among these cases, one or two have at times been regarded as offering examples of hydatids formed in the prostate itself. But I think evidence is wanting to show that they were so.

The Male Urethra.

Congenital malformations.
Injuries.
Inflammation.
Stricture of the urethra. { organic. / spasmodic. / inflammatory.
Tumors of the urethra.
Urinary abscess, acute and chronic.
Urinary fistulæ.
Retention of urine.
Extravasation of urine.
Rupture of bladder (from retention of urine).

Congenital aberrations and malformations.—1. Absence of the urethra is occasionally met with, as in cases of extroversion

of the bladder, in which there is neither any cavity nor reservoir to contain the urine, nor any canal to carry it off; but a mucous membrane, corresponding with the posterior surface of the bladder and with the floor of the urethra, alone remains. For further description, see "*Malformations of the bladder*," p. 753.

2. The canal is sometimes occluded, and this produces retention of urine, and death during the early hours of life. The obstruction may consist merely of a membrane forming a diaphragm across the canal, or of an obliteration of some lines in length, and it may occupy any portion of the tract, but is usually found near the vesical orifice.

3. Deficiency of a portion of the urethra near the anterior orifice is the most common deformity. When a part of the upper covering is deficient, and the mucous membrane of the lower part, or floor, is exposed, the condition is termed *epispadias;* when the contrary condition is presented, the deficiency being that of the floor, the term *hypospadias* is applied to denote it. The degree of deficiency varies considerably; from a quarter of an inch to an inch and a half may be absent in either case. Occasionally, and this is only a variety of hypospadias, a second meatus exists, usually about an inch behind the normal one, opening externally through the floor of the urethra. But the opening may be much further back, and may even render impracticable the ejection of semen into the vagina.

4. Besides these, slight exaggerations in the size or form of the natural parts may be occasionally noted; as of the lacuna magna, the sinus of the bulb, and the sinus of the verumontanum. Not very unfrequently there is congenital narrowing of the external meatus, or of some portion of the passage situated within an inch of it.

Treatment. — The simple diaphragm may be perforated by a trocar, or point of a bistoury, when its existence has been clearly ascertained. The congenital narrowing of the external meatus may be dealt with as stricture in that situation. None of the other conditions, with one exception, are improved by the various procedures, by paring and suture, which have from time to time been practised, nor are they sufficiently important to be so treated. But hypospadias existing or extending far back, so as to produce a practical impotence, should not, under such circumstances, be refused the possibility of remedy by surgical operation. This has been accomplished by a combination, of perforating the anterior portion of the penis, paring the edges of the opened urethra, and uniting by suture. Much care and skill, however, are necessary to give the patient any chance of a cure.

Injuries of the urethra. — (See vol. i. p. 826 et seq.)

Inflammation of the urethra. — (See the essay on GONORRHŒA.)

Stricture of the urethra. — The term stricture implies an unnatural contraction of the urethral canal, congenital or acquired. Contraction may occur in two forms: it is the nature of the first to be permanent, and of the second to be transitory only, as regards its duration. A permanent contraction is due to organic deposit in or around the walls of the urethra, and is accordingly termed organic or permanent stricture. A transitory contraction is supposed to be due either to local vascular inflammation or congestion, causing temporary narrowing of some part of the urethra, hence the term inflammatory or congestive stricture; or to unwonted muscular action alone, of the voluntary or of the involuntary fibres, in which case it is designated spasmodic stricture. This last-named condition, that of spasm, may exist alone, but is usually found as a complication of the other kinds. The term spasmodic is understood to include only cases in which involuntary contraction of the muscular fibres constitutes the main source of obstruction. So also the term inflammatory stricture can only be employed when the diminished calibre of the urethra is mainly due to an attack of inflammation.

But the terms implying temporary stricture are liable to cause confusion and misapprehension. Obstructed micturition from inflammation has its origin in the prostate when swollen through an attack of that nature, and is improperly described as *stricture;* just as we have tonsillitis obstructing deglutition, but which is never spoken of as stricture of the throat. Obstructed micturition from mere spasm of the muscular parietes of the urethra must be excessively rare, although, no doubt, spasm complicates previously existing morbid changes there. Hence I prefer to restrict the term stricture of the urethra to those narrowed conditions of the canal which depend on organic changes in, and immediately surrounding, its walls; in other words, I shall use the word stricture as synonymous with the terms organic or permanent stricture, and as implying nothing more.

Anatomical classification. — Strictures present themselves in a variety of forms. For anatomical purposes all these may be ar-

ranged in four groups, by which means it is easy to designate any specimen, according to the physical characters of the stricture itself. It will then be only necessary, for the sake of further description, to speak of it as more or less narrow, and name the region in which it is situated.

1. *Linear stricture.*—The urethral canal may be obstructed by a thin membrane stretched across it, with an aperture in the centre, or on either side of it, and having an appearance, in relation to the rest of the passage, somewhat resembling that of the pyloric orifice of the stomach. It occasionally happens that a fold of the mucous membrane obstructs the passage at one of its sides only, forming a crescentic septum, and so obstructing a segment of the calibre of the canal: these constitute what has been called "the bridle stricture."

2. *Annular stricture.*—Those instances in which the contracted part is thicker and broader than the foregoing description would include, have been termed annular strictures, which present an appearance as if a piece of cord had been tied round the canal at one point, leaving the remainder free.

3. *Indurated annular stricture.* — This term may apply to those cases of confirmed stricture in which the induration is seen to extend into the tissues around the urethra, to the depth of half a line or a line: although it may be limited in extent from before backwards to a space occupying less than half an inch of the canal. The centre of the space is the point at which the contraction is most considerable, so that the affected portion presents a form somewhat resembling that of an hour glass; and it is worthy of remark that the induration is generally thicker at the floor than at the upper aspect of the urethra.

4. *Irregular or tortuous strictures.*—In a few instances, some of the natural rugæ of the urethra seem to be adherent, or even fused together, for the space of a few lines in length. In very rare cases a patch of indurated tissue is seen, resembling a cicatrix, around which the mucous membrane is puckered in radiating lines; the amount of contraction appearing to correspond with the extent of previous loss of substance. But occasionally the contraction extends longitudinally for a considerable distance, and the canal is narrowed, and its walls thickened on all sides, for a length of one or more inches. In these cases the induration sometimes involves the entire substance of the corpus spongiosum, and gives rise to the most obstinate and undilatable form of stricture.

Occasionally several separate strictures may be observed in the same subject. John Hunter records an instance in which he met with six strictures in one urethra.

Fig. 443.

Long and indurated stricture at the junction of the bulbous with the membranous urethra. Much dilatation of the urethra and its lacunæ behind.

Lallemand and other French writers describe seven or eight. I have never been able to find any such examples. Three,

Fig. 444.

An irregularly narrowed condition affecting the anterior part of the urethra, the narrowest point being rather more than two inches from the orifice (drawing half size of nature). Dilatation of urethra and of lacunæ behind.

or at the most four, distinct contractions is the highest number I have seen, and the latter is rare.

Origin, nature, and site of stricture.—The first effect of inflammation upon the mucous membrane is a swelling or thickening of it, caused by engorgement of the ves-

sels. Then exudation of an albuminous fluid takes place into the submucous tissue, and perhaps becomes absorbed under favorable circumstances. But when the morbid action persists, more or less plastic material is thrown out, the result of which is the formation of fibrous tissue around the canal, causing adhesion between the mucous membrane and the submucous tissue, infiltrating the meshes of the latter, and even involving the substance of the corpus spongiosum itself.

A widely-differing condition to any of those above described has been referred to by some under the title of stricture. Sometimes, but by no means frequently, an exudation-deposit upon the surface of the urethral mucous membrane is said to cause occlusion of the canal. Few cases are on record, nor are many examples to be found in our museums; and it is now quite certain that this condition must be regarded as extremely rare.

Speaking in general terms, the degree of contraction is proportioned to the duration of the complaint, and to the extent of the inflammatory action which has existed; although the severity of the symptoms, the amount of distress, and the effects on the constitution, are by no means always commensurate with the amount of narrowing which exists. It is very rare indeed to find the urethra altogether impervious during life to the flow of urine. However contracted the canal may be, the urine still issues either in a very small stream or by drops. Retention does not depend on absolute organic impermeability. It is easy to conceive that when the canal is contracted to a mere pin-hole, the slightest cause may operate to occasion total obstruction; a little tumefaction of the part, a pellet of thick mucus, a flake of fibrinous deposit, or a very small calculus, are quite sufficient to block up the channel. Probably the sides of the urethra never adhere, and cause obliteration of the canal; unless indeed fistulæ have been established, when, although very rarely, this accident may happen in that part of the canal which is anterior to the stricture. But even then it occurs almost invariably in those strictures which are of traumatic origin. The urethra may be cut across by a wound in the perineum, and for want of proper attention the urine may pass entirely through the artificial opening, and adhesion seal up the proper passage. But such obliteration is a wholly different thing from stricture, and ought not to be confounded with it.

Locality of stricture.—After a laborious investigation of this subject, respecting which there has long been much difference of opinion, comprising the examination of 270 preparations in our principal museums, I have arrived at the following results. All examples of the disease may be comprehended, in relation to this inquiry, in three distinct classes:—

1. *Strictures occurring at the sub-pubic curvature, i. e.*, at the junction between the spongy and membranous portions and its vicinity; the latter term comprising an inch of the canal before, and three-quarters of an inch behind, that point, thus including the membranous portion.

That part of the urethra which is most frequently affected with stricture is the posterior or bulbous part of the spongy portion. The liability of this part to stricture appears to diminish as it approaches the deep fascia, behind which stricture is very rare. Most rarely is a stricture found so far back as the posterior part of the membranous portion.

2. *Stricture occupying the centre of the spongy portion, i. e.,* a region extending from the anterior limit of the preceding to within two inches and a half of the external meatus, and measuring therefore about two and a half to three inches in length.

3. *Stricture occurring at the external orifice, and within a distance of two inches and a half of it.*

The following is an analysis of the 270 preparations referred to; they exhibit 320 distinct strictures:—

Total number of strictures, 320:			
" in region 1	215,	or 67 per cent.	of the entire number.
" " 2	51	" 16 "	" " "
" " 3	54	" 17 "	" " "
	320		

Of these

There were 185 examples of *one stricture only*, situated in region 1.
" 17 " " " " " 2.
" 24 " " " " " 3.

There were 8 *cases* in which the urethra was strictured in all three regions.
" 10 " " " in regions 1 and 2 only.
" 10 " " " " 1 " 3 "
" 13 " " " " 2 " 3 "

Respecting so-called "prostatic stricture," it may suffice to state that there is not a single case of it to be found in any one of the public museums of London, Edinburgh, or Paris, nor have I ever met with an example. It must be concluded that some observers who describe prostatic stricture have been deceived in reference to it, or that it owes its supposed existence to inferences drawn from the results of examinations of the living body, which can by no means be admitted as evidence on this subject.

Causes of organic stricture.—There are two principal and distinct species of lesion which give rise to the formation of stricture of the urethra. The first, and that which by far the most frequently operates, is inflammation in the canal; the second is injury by violence.

The first-named process, viz., the inflammatory, in the great majority of cases, fortunately terminates by resolution, and leaves the urethra as healthy as before. Whether the urethritis be gonorrhœal, or of non-sexual origin, that is the ordinary result. But in exceptional cases, occurring in some instances probably from indiscretion on the part of the patient, in others from violent treatment, and in others from a constitutional indisposition to terminate inflammatory action, this latter persists and produces the deposit which ends in stricture as before described. This last-named cause is not a speculative theory, for I am now quite satisfied that in certain families individuals inherit a proclivity to the formation of stricture. It is not therefore acute gonorrhœa, but a persisting chronic or subacute affection, which seems to lay the foundation of organic stricture. Hence a long period often elapses between the acute attack and the first symptoms of obstruction. These latter appear often very insidiously and slowly, and at first perhaps scarcely excite the attention of the patient. Thus it is that a period of many years is often passed before the existence of the organic change has become obvious.

The next principal cause of stricture is mechanical injury. Blows on the perineum, bruising, lacerating, or partially destroying the urethra, are received in a variety of ways: by falls on some hard object, as across spars, scaffolding, ladders, chairs, gates, wheels, saddles, etc.; or on some sharp object which punctures the perineum, as palisading and other fences, from earthenware vessels which break under the sitter, etc.; again, laceration may occur from the bones in pelvic fracture; lastly, all violence in the use of surgical instruments must be admitted as another traumatic cause. In all these cases the wounded urethra often unites irregularly, or loss of substance takes place, and the cicatrix resulting permanently contracts the part. The strictures so formed are among the most obstinate and difficult to treat which come under our care.

An occasional cause of stricture is cicatrization following chancrous or other ulcers which have occasioned loss of substance. The results of these are usually observed at the external meatus. After amputation of the penis, the opening of the urethra is also sometimes narrowed in a similar manner.

Narrowing of the urethra, occurring generally within half an inch or an inch of the external meatus, is occasionally met with as a congenital formation. It is remarkable that it may exist up to the period of adult life without occasioning the smallest inconvenience, indeed without being discovered, and subsequently become the source of severe symptoms. The tissue appears to become in later life less extensible, and to interpose a serious obstruction to the outflow of urine.

Symptoms.—Among the early symptoms, slight urethral discharge is often noted, and its presence sometimes masks the true cause. Pain is usually felt in the urethra, behind the stricture, at the time of micturition. The contents of the bladder are emptied at shorter intervals than has been natural. The stream is altered in form, becoming more or less flattened; perhaps twisted, spirting, forked, or even divided; which conditions are caused by the current of water being insufficient in size and force to dilate and extend the lips of the meatus externus; but it must not be concluded that the mere existence of such a stream is a proof that stricture exists, since many persons, from a tumid condition of the meatus alone, habitually pass such a one. As contraction increases the stream grows smaller, the momentum of the current is lost, and in time the urine may issue only by drops. Generally speaking, the act of micturition is always prolonged to an extent corresponding with the degree of obstruction present. Ultimately the acts of micturition become very frequent and painful, some patients being compelled to rise from bed many times in the course of the night; while in the worst cases, or during temporary exacerbations, a great portion of the time is spent in laborious and unavailing efforts, by change of posture or by straining, to obtain some relief. Tenesmus of the rectum is thus often induced, leading to protrusion of the mucous membrane through the external sphincter, and sometimes to troublesome prolapsus. In bad cases the patient can rarely attempt to empty his bladder without visiting the

water-closet, through his inability to prevent the escape of the contents of the rectum from the efforts required for that purpose. Pains in the peritoneum, the testicles, the loins, and the hypogastric region are usually present in such cases.

In some few cases the most prominent symptom throughout is retention. There may be but little irritability of bladder, and the stream of urine, when passed, is not necessarily very small; a No. 6 or 7 catheter may pass through the urethra; but a true organic stricture is present, and may perhaps be verified by the touch, as a ring of indurated material in the course of the urethra. The patient is liable to frequent retention, and finds no relief but from catheterism, while attempts at dilatation are followed by inability, more or less prolonged, to pass water, until an instrument of very large size has been reached.

The urine also shows signs of change, which become more marked in proportion as the case advances. A portion being retained in the bladder, from inability to overcome the obstruction, the secretion becomes partially decomposed, and irritates the mucous membrane; and thus urine, cloudy, ammoniacal, and depositing as it cools a quantity of pus and mucus, is not an unfrequent accompaniment of stricture. It is usually alkaline, deposits slimy tenacious mucus, and also a precipitate of the prismatic crystals of triple phosphate of ammonia and magnesia, of exudation or compound granular corpuscles, epithelium, and some pus; while on its surface an iridescent film or pellicle collects, commonly consisting of the triple phosphate, and sometimes of the phosphate of lime. Hematuria is also one of the occasional concomitants of stricture. Blood sometimes comes from the bladder, in small quantity, communicating a dark tint to the urine. It frequently follows the use of the catheter, but it appears also when no instrumental interference has taken place; or it may be due to the rupture of vessels during erection, the urethra being unduly confined by the presence of the stricture, and strained by the act (see Hematuria, p. 751).

As the case advances, attacks of complete retention, depending on the causes above mentioned, become more frequent. The urine is at length habitually discharged by drops, so that a stream cannot be said to exist. Sometimes the urine passes away involuntarily during the unconsciousness of sleep, or during muscular exertions; and at length the patient loses the power to retain it altogether. At this stage 'incontinence' is often said to occur, which term does not here apply either to an irritable or to a paralyzed condition of the bladder, incapacitating it to retain its contents, although it has frequently been mistaken for this. The urine constantly dribbling off infects the patient with a urinous odor, and, despite all precautions, excoriates the skin, stains the clothes, and renders him offensive to himself and others. But these symptoms, in nine cases out of ten, indicate that the bladder is distended, and that the surplus only runs off in the manner described, the organ remaining filled with the staler portion of the urine, unless it be frequently emptied by the catheter. Thus it is a state of retention, or of engorgement, rather than of incontinence. The extent of dulness on percussion over the pubes will indicate this condition, and also the size of the tumor formed by the distended viscus. Under these circumstances disease of the bladder is increased, and disorganization more readily induced than before. Thus ulceration may occur in its mucous membrane, or in that of the urethra behind the stricture. Under such circumstances, in a paroxysm of straining to pass water, rupture of the urethra may take place, and extravasation of urine occur into the cellular interspaces in the perineum, scrotum, and supra-pubic region (see Extravasation of Urine).

Besides the local symptoms of stricture, there is usually disorder of the digestive organs, followed by the consequences of impaired nutritive function. The patient loses flesh and strength, looks anxious and careworn, complains of pains in the back and loins, and often becomes the subject of severe attacks of shivering. Others invariably experience rigors after the passage of a bougie, or if an instrument but one number larger than the accustomed size be passed. Such an occurrence appears to be more common among those who have long inhabited warm climates. The application of an irritant or corrosive substance to the urethra is also not uncommonly followed by some general fever. So well known is this phenomenon that it has received the special name, and not inappropriately, of "urethral fever." It often occurs after the first act of micturition following the application of the irritant, as if from contact of urine with the abraded urethra, or with the wound if incisions have been made. Sometimes it is intermittent in its character. When renal disease exists, these symptoms are more prone to occur; so that we may suspect the presence of such disease when severe rigors constantly follow slight urethral irritation in patients not predisposed, by climate or otherwise, to experience them, and who have suffered for some time from stricture. I have observed, on more than one occasion, suppression of urine, rapidly followed by

death, to result from the introduction of an instrument larger than the patient has been accustomed to; or again, when the ordinary instrument has been less skilfully employed, and an abrasion, although only an exceedingly slight one, has been made in the mucous membrane of the urethra. The rapidity with which death may occur, under these circumstances, in patients who are the subjects of extensive chronic disease of the kidneys, from an apparently exceedingly trifling lesion so caused, is remarkable. It seems to be due to uræmic poisoning; the post-mortem appearances, to the naked eye, do not necessarily exhibit traces of inflammation resulting from the particular lesion. In these cases it appears that the function which determines the elimination of urea suddenly ceases after slight injury to the urethra, as by the propagation of some shock to the excreting organ, in cases where the kidneys are largely diseased. And there are undoubtedly sometimes, although rarely, instances in which the fatal result ensues in this manner from the mere passing of a catheter, although it is absolutely certain that no mechanical injury whatever has been inflicted.

From the symptoms which present themselves three classes of organic stricture may be made, which will embrace all the varieties of the disease, and so serve as a means of describing in brief terms any particular example in the living patient.

1. *Simple stricture.*—Its chief sign is diminution in the size of the stream; there is increased frequency of micturition also, with some pain, although the amount of either varies greatly in different cases.

2. *Sensitive or irritable stricture.*—Proneness to disturbance of the nervous system, as evidenced by chilliness, irregular circulation, or even rigors on very slight irritation. Great pain is caused even by the gentle application of instruments, and it continues sometimes long afterwards. In a few cases also a disposition to hemorrhage is manifested.

3. *Contractile or recurring stricture.*—There is constant tendency to become narrower in the absence of treatment; and contraction rapidly recurs after dilatation has been applied.

Diagnosis and treatment. Dilatation.—The symptoms just detailed are not sufficient alone to establish the presence of stricture; it is necessary to examine the urethra with an instrument to ascertain whether an organic obstruction exists, whether one or more are present, their calibre, and what extent of the canal is involved.

For this purpose instruments of various forms and compositions are used; some are soft and pliable, others are elastic, others inflexible and solid. Some are solid throughout, mostly called bougies; others are hollow, to permit urine to flow through, and are termed catheters. As a rule the flexible instruments, whether hollow or solid, are less irritating to the urethra than the inflexible, and I advise their employment in most cases. They are of two kinds, each made in two forms. The English gum-catheter has a considerable amount of firmness when cold, but is very flexible if placed in water at 100° to 110° Fahr., and will retain when plunged into cold water almost any form communicated when warm. This quality is of extreme value, especially in the treatment of enlarged prostate, where a well-curved instrument is required. Ordinarily they are mounted on curved stylets, which maintain the desired form, but the stylet, as a rule, is to be withdrawn from the catheter before using it. Bougies of the same material are susceptible of similar treatment. Formerly they were made of wax, hence the name, but they have fallen into disuse, being replaced by better materials.

The French instruments are much softer and more flexible than the English, and may be made either curved or straight, not taking any other form than the original one. But their extreme flexibility enables them often to traverse the urethra without pain or even discomfort to the patient, and sometimes even when solid instruments pass with difficulty. Perhaps, as a rule, no instrument passes either in a healthy or in a strictured urethra, provided the obstruction is not exceedingly narrow and tight, so easily and readily, for the majority of cases, as the French bougie, which tapers for one-third of its length almost to the end, this consisting of a bulb half the size of the full calibre of the instrument (see fig. 445). The long and extremely flexible extremity readily insinuates itself through the passage; and were the instrument to end in a fine point, this might readily be caught in some lacuna, but the terminal bulb prevents this, and the merest tyro can generally pass it at once into the bladder. In doing so, if the patient stands, the bougie being oiled, is merely introduced and pushed horizontally inwards, without any attempt to direct its progress. The bulb-ended bougies and catheters, often but less appropriately termed "olivary bougies," are often of extreme utility both to the surgeon and to the patient who requires them for his own use, but they are quite unsuitable to hot climates, where for the most part metallic instruments are necessary.

To introduce the silver catheter, and supposing the patient to occupy the stand-

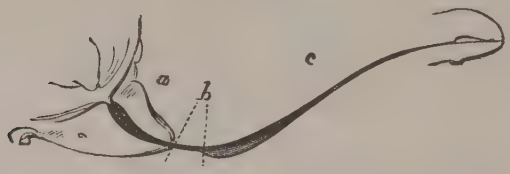
ing position, the following plan may be adopted: Let the handle or upper end of the instrument be lightly held between the thumb and the fore and middle fingers of the right hand, the concavity of the curve looking towards the left groin of the patient, and the general direction of the instrument being almost horizontal. The penis is to be raised with the left hand, the point of the instrument inserted into the urethra and slowly carried onwards until four or five inches have

Fig. 445.

Bulb-ended bougie and catheter.

disappeared; the handle is brought to the middle line at the same time, at first close to the patient's abdomen, after which it is to be gently and lightly depressed; and as the point is felt to traverse the sub-pubic curve, the handle is gradually brought down towards the operator, until it sinks beneath the horizontal line, when the opposite extremity will be free in the bladder. If difficulty occurs, the direction of the instrument may be slightly altered, or it may be withdrawn an inch or so, and then re-introduced with the handle more upright than before, or the reverse, as the case may require. If, notwithstanding all, the instrument is stopped point blank, and at the same spot on each trial, there is reason to suppose that stricture is encountered. On the other hand, if the urethra is healthy, a solid sound of good size will pass almost by its own weight if lightly handled; at all events, a very slight pressure from the forefinger upon its handle will be amply sufficient, if additional impetus be required. The main point is to allow the point to slide easily along the *upper* surface of the urethra. It will not then be caught in the depression of the bulb on the floor of the urethra, nor will it be so likely to be impeded in the sinus of the prostate. (See the annexed diagram representing a section of the urethra throughout its course.) It is never to be forgot-

Fig. 446.



Section of the urethra. *a*. Prostatic. *b*. Membranous. *c*. Spongy portion.

ten that a powerful lever is in action when the handle is depressed, the resistance of which bears on structures which may be easily perforated if undue force be applied. Whatever the obstruction, it is never to be forced: temper, patience, and a light hand will overcome almost all cases of difficulty. All attempts at rapidity of execution are wholly out of place, fraught only with danger to the patient, and calculated to reflect discredit on the operator.

That mode of passing a catheter which has obtained the name of the "tour de maître," can be only necessary with an extremely corpulent patient. It consists in introducing the instrument with the convexity of its curve upwards, and with the handle in a perpendicular line beneath; in carrying it to the deep perineal fascia in this direction, and when it has arrived at that point, in sweeping it round adroitly so as to describe a half circle, of which its point is the centre; at the same time gradually depressing the handle to carry the instrument through the sub-pubic curve.

When much time is required, the recumbent position is generally best. The head and shoulders should be slightly elevated by pillows, and the knees a little raised and separated from each other; the operator should stand on the left side of the couch, hold the catheter as before directed, and introduce it over the patient's left groin, the handle being in the horizontal direction; he should support the penis with the left hand, placing the palm upwards, so that the middle and ring-fingers hold the penis just behind the corona glandis; the index-finger and thumb are then at liberty to be applied

for the purpose of retracting the prepuce if necessary. The beak of the instrument having been introduced, it should at first be maintained against the inferior wall of the canal, to avoid a lacuna on the roof, sometimes considerably developed; an accident which gives the patient pain, and sometimes disconcerts an operator. The fingers of the left hand gently draw the penis over the instrument as it glides easily on to the bulbous part, the handle still being horizontal, or nearly so; arrived at which, if some obstruction seems to offer, the instrument should be withdrawn an inch or so, and again passed, taking care not to elevate the handle so soon; after which, by gently raising it and causing it to describe a curve along the middle line, the extremity will probably glide slowly upwards into the bladder as the handle sinks towards the interval between the patient's thighs. In passing an English, gum-catheter, take care that it is well curved after the stylet is removed, as the warmth of the urethra tends to straighten the instrument, and so occasion it to hitch on the floor on arriving at the membranous portion. The point should be well turned up, and the curve maintained in passing the first half of the catheter very close to the belly of the patient, after which a rather quick depression of the shaft carries the point easily into the bladder.

In exploring the urethra, especially if the symptoms are not well marked, we are not hastily to conclude, because a little obstruction presents itself in the passage, that stricture is of necessity present. The part is extremely sensitive, and resists any but gentle efforts to traverse it, the more so if it be the first time an instrument has been introduced. Sometimes at the neck of the bladder itself a little more than usual depression of the handle of the catheter is required, or it may be necessary to employ an instrument with a stronger and longer curve.

The size of an instrument to be first used is by no means a matter of indifference. As a rule, whatever statements the patient may make, we should *always* use a bougie or catheter, not smaller than No. 7 or 8, with a blunt, not conical or bulbous extremity, as the former affords a far more certain indication of the situation of the obstruction than a small instrument, which might pass through a slight constriction altogether; or whose point may be entangled in a lacuna, or in a fold of mucous membrane, the first of which would have been closed, and the second obliterated, by the passage of an instrument sufficiently large to fill the urethra. By such entanglement, perhaps, injury may be inflicted on the canal, or the unfounded belief in the existence of abnormal obstruction in it may be induced.

Suppose, however, that a stricture is encountered, its distance from the external meatus should be accurately noted and its situation remembered. Then a smaller instrument is to be passed, in order to determine the calibre of the stricture: if this enter the contracted part, it is at once obvious by its being "*held*," *i. e.*, it has entered a narrower passage which fits closely to and retains it, so that on attempting to withdraw it, some force is necessary for the purpose. A trial of several instruments may be necessary, until at last one which is sufficiently small to enter the constriction is arrived at; but we should always bear in mind that the smaller the instrument the more careful and the more sparing of pressure must the operator be, since such an instrument will inflict a wound with ease directly proportioned to the smallness of the point.

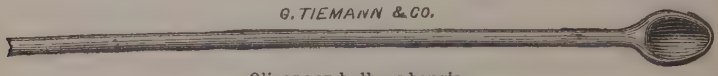
The method just recommended I have found generally sufficient to determine the existence of stricture under ordinary circumstances. When it is desirable to have an exact knowledge of the length to which the canal is affected by narrowing, a bulbous-ended instrument, of which the shaft is slender, may be employed for the purpose. It is rarely necessary to employ them, although before performing urethrotomy it is as well to do so. For this purpose instruments must be used with bulbs of various sizes, from about No. 2 to No. 7, the stems of the smaller to be equal to that of a No. 1 catheter, of the larger about No. 2 or 3. One of these is found, the bulb of which will pass with slight pressure through the stricture, when it is felt to be free and easily movable beyond. On withdrawing, as it passes outwards through the constriction a little obstruction is encountered. In this manner, the extent of contracted urethra, generally comprised within a range of the fourth or half of an inch, is readily estimated. So also the existence of another stricture beyond the first may be demonstrated in the same way.

[This bulbous bougie (fig. 447), is an instrument of great value in locating strictures in the pendulous urethra, and deciding their extent. They are furnished by instrument-makers of woven material, French or English make, as well as constructed of metal, whalebone, etc. A number of very ingenious instruments have also been devised to act as a universal *bougie à boule*, but a set of the simple bulbous sounds, made of whalebone or metal, will prove most useful in the end.

A blunt (not conical) steel sound is probably the best instrument with which

to detect a stricture at or beyond the bulbo-membranous junction, and the general surgeon will find it more easy to keep a full set of conical steel nickeled sounds, in good order, always ready to treat a case of stricture by dilatation, than he will to keep provided with perishable French conical bougies. It must be remembered, however, that extra care and intelligence are necessary if conical steel

Fig. 447.

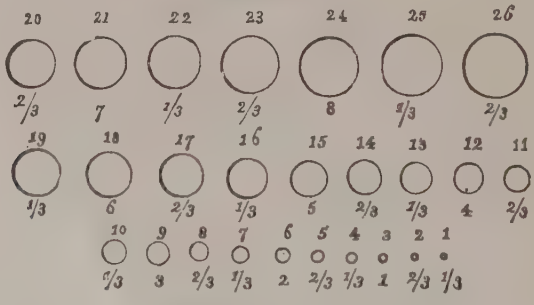


Olivary or bulbous bougie.

instruments are used in the urethra, and that it is rarely allowable for any one but a master to use any metallic instrument in the urethra smaller than 10 French, unless that instrument be conducted upon a guide.]

Of late years attempts have been made to examine the urethra and bladder, not merely through the sensations obtained by touch from an instrument, but by vision also. For this purpose a straight metal tube (the "Endoscope"), which may vary in size between 9 or 12 of the catheter scale, is used for the urethra, and one in the form of a beaked sound with a piece of glass at the angle for the bladder. To the tube when introduced a lamp is adjusted, with eye-piece and reflector, so as to throw a pencil of powerful rays on whatever substance impinges directly on the bottom of the straight tube. Whatever this is, being comprised within a circle of about the $\frac{1}{8}$ or the $\frac{1}{4}$ of an inch in diameter, is visible to the observer looking through the eye-piece and the perforated reflector. The same tube may be employed also with an ordinary jet of gas or with sunlight. I have tested various endoscopes on numerous occasions during many years past, and I am compelled to say that I do not find any advantage to be derived from their use in the treatment of stricture, or of any disease of the bladder. It is easy to see the color of the mucous membrane of the urethra and of the bladder touched by the tube; also to see that very small portion of a calculus against which the end of the tube rests. No illumination of the cavity of the bladder can be made; this being filled with urine, mostly in disease more or less cloudy and opaque, less is visible there than in the urethra, and in the latter spot it is difficult, indeed rarely possible, to discover the orifice of a stricture, or to identify even characteristic structures proper to the canal. Differences of color are those only which are readily appreciable. The employment of such an apparatus, moreover, is not to be regarded by any means as a painless proceeding, to say the least of it; commonly it is productive of much irritation. With a large tube suited for examining the rectum, the result is very much more satisfactory.

Fig. 448.



English scale for catheters.

Hitherto, in speaking of the sizes of urethral instruments, the English scale has been always assumed, as being that best known in this country. The scale, however, of the French is better, as producing smaller intervals between each number, in making these intervals more regular, and the number itself to express the measure of the calibre marked by each instrument. No. 1 is one millimetre in circumference, No. 2 is two millimetres, and so on up to 30. The Nos. 3 to 21 represent pretty generally the Nos. 1 to 12 of our scale, that is, about 18 numbers instead of 12. A fac-simile of the metrical scale is seen in the figure 448.

Treatment.—Its object is twofold:—

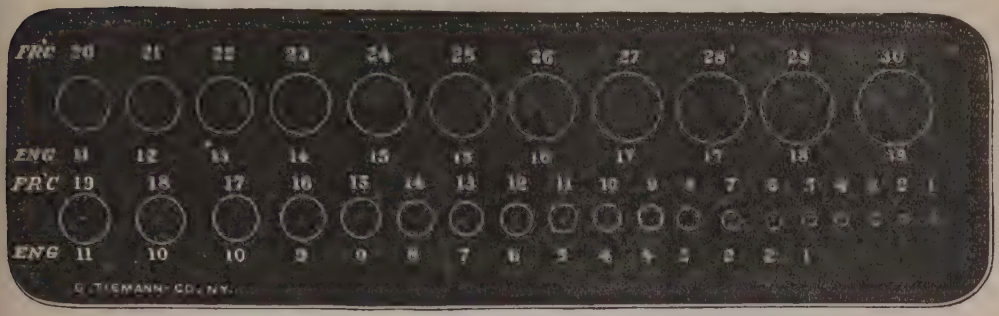
First, to restore the natural calibre of

the canal, so far as is consistent with the safety and comfort of the patient.

Secondly, to maintain the adequate patency of the canal afterwards.

Now, since strictures vary in amount of contraction, in dilatability, in disposition to return, in local sensibility, and in liability to manifest sympathy with other parts of the body, etc., various modes of treatment are necessary, appropriate to

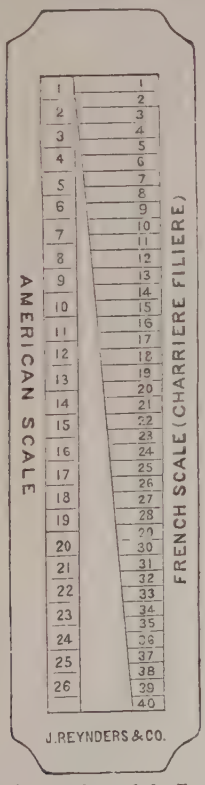
[Fig. 449.]



French scale. The corresponding English numbers are also shown.

different cases. Hence, innumerable inventions for the fulfilling of the above in-

[Fig. 450.]



Comparative numbers of the French and American scales.

dications have been described, and modes of treatment proposed. All, however, may be resolved into three classes. The opposing tissue of the stricture is either dilated, gently or forcibly; or it is wholly or partially destroyed by chemical agents; or it is divided by some cutting instrument; and of course all these processes may be more or less combined with certain general or constitutional treatment.

Dilatation.—This is the mildest and most desirable treatment to employ whenever the case admits of it; it is also the most generally applicable, and the best adapted to a very large proportion of all the cases presented to our notice. It is the method which almost all surgeons agree to use as the rule, availing themselves of other means when its action after fair trial is found to be inefficient. The history of surgery shows that it is still the most ancient mode, having been employed for the destruction of "carnosities" in the time of Galen, and never having been superseded to the present day.

To apply it in ordinary cases, a flexible bougie, as large as the stricture will easily admit, should be passed fairly through it, and then be at once withdrawn with as much care and gentleness as was employed in introducing it: a note of the size should be recorded, and the patient desired to come again in two or three days: the same may then be passed, perhaps with greater ease than before; if so, it is to be withdrawn at once, and the next size larger introduced, provided it requires no undue force to do so. The visit is to be repeated as before, if neither pain, nor bleeding, nor much smarting in micturition, follow and continue after the operation. Sometimes a fit of shivering occurs, or the patient may be faint or sick, which are not unfrequent effects of

the passage of an instrument, more especially for the first time. If any of these phenomena take place, the interval should be lengthened a day or two, and the condition of the health examined. If the patient complains of soreness of the urethra, and that micturition is painful, the urine is, perhaps, unduly acid, and it will be desirable to regulate his diet and habits so as to promote a healthy character in the secretions generally. At the same time, if it be so, he will generally derive benefit from a little bicarbonate or citrate of potash, combined or not, as occasion may require, with hyoscyamus, and taken three or four times a day; or, the alkali may be given in infusion of buchu, if the mucous membrane of the bladder seems to be irritable, or disposed to secrete too freely. Irritability of the urethra, however, is much allayed by the gentle and careful use of instruments. Even when much suffering is produced at the first attempt, it usually becomes notably less at every succeeding passage of the sound. Supposing none of these consequences to happen, the same plan of gradual advance may be continued at each visit, so that No. 11 or 12 may be soon safely reached in such a case as that described, when a very fair amount of dilatation has been achieved: if the urethra is of the ordinary size, if the last step or two in the progress have been easily made, without pain or annoyance to the patient, it is well to go on to No. 12 or 13. Finally, the maximum point of dilatation arrived at should be maintained for a short time, the largest-sized instrument employed being used at gradually increasing intervals of time, in order to maintain the ground which has been won.

If, however, the case is more difficult, and after the use of a smaller instrument no penetration is effected, it is desirable to see the patient make water; if the stream is small, the size of the instrument should correspond with it; if it is not, the contraction cannot be very considerable, and some fold of membrane, or perhaps a false passage, has entangled the point; and in any case the bougie to be tried next should be as nearly as possible of the size of the stream. In introducing it, the floor of the urethra, as well as any lateral deviation in its course, are to be avoided, these being favorite situations for false passages. Failing of success in one direction, we should next cautiously carry the point towards others, trying patiently for a short time to insinuate it either above, below, or on either side of the passage, if the slightest sensation of its being "held" indicates that the orifice exists in any of these directions. And when the instrument has thus become a little grasped, we should endeavor to facilitate its progress by patient, continued, and moderate pressure, the precise amount of which should be proportioned to the degree which the patient will bear without much complaining. Some minutes should be devoted to the attempt, the success of which will much depend upon the steadiness and singleness of purpose with which it is pursued. Sometimes the introduction of the left forefinger, previously oiled, into the rectum, will facilitate the progress of the instrument, either by permitting its point to be raised to some extent, or by enabling us to judge more precisely of its exact locality and relation to the parts around; above all, whether it is or is not in a false passage.

The employment of continued pressure on the face or commencement of an indurated and not very sensitive stricture, is sometimes successful, either by inducing absorption, or by mechanical action upon the yielding materials of the obstruction. The operator, however, should be certain that he is really acting on the contraction, and not following or making a false passage. It is important to remember, as an invariable rule in relation to these attempts, that when the instrument is tightly grasped, the operator may infer that its point is safe within the strictured part, and that when the point feels free, movable, and capable of being withdrawn without appreciable effort, it is certainly not in the stricture; it may be, in such circumstances, in a false passage. If, after being grasped or "held," it advances suddenly for a short distance under pressure, and becomes movable, it is probable that a false passage has been made and the urethral walls perforated; after which unfortunate occurrence all further efforts must be given up, at least for several days, and the employment of instruments, when again resorted to, must be conducted with vigilant care, to avoid any re-opening of the lacerated part.

If, after several applications of the instrument, the stricture is still not passed, or if the case at its commencement appears to be more than usually difficult, we must take still further precautions to insure success. It is preferable to visit the patient when in bed, with the skin warm and moist from ample coverings. A hot hip-bath just before the visit is sometimes advantageous. When introducing the instrument, all unnecessary exposure should be carefully guarded against. Premising that the situation of the stricture has been carefully verified beforehand, a silver catheter should be selected, the size of which should be little less than that of the stream of urine. Perhaps it is sometimes desirable to apply the oil *to the urethra itself*, rather than to the instru-

ment, injecting, by means of a common glass syringe, four or five drachms of olive oil. This proceeding facilitates the progress of a small instrument to the stricture, and tends to open the latter by the penetration of the oil into the narrowed passage itself.

When the stricture has been passed, considerable care is necessary in guiding onwards the point through the canal behind, to prevent its becoming engaged in the enlarged lacunæ which are commonly found here. These are usually on the floor; and not a little patience and management are sometimes required to carry the point of a slender instrument over them and lodge it safely in the bladder. Usually the point has to be tilted upwards somewhat; and here it is that the finger in the rectum is most commonly of use.

False passages are some of the most perplexing complications of a narrow stricture which the operator has to deal with, inasmuch as the difficulty of getting into the right opening is greatly increased by the readiness with which the instrument enters the wrong one. It is to be remembered that, as a rule, false passages most frequently commence on a level *below* that of the proper opening; and that the operator's finger when in the rectum, near to which the false passage is almost certain to run, will inform him as to the route which the catheter is taking, whether it be too close to the gut or deviating to the right or left of the median line, and will also assist him to direct the point in its true course.

[Probably no instrument has been invented which affords more aid to the surgeon in threading a tight stricture than the whalebone filiform bougie, with its point bent, or twisted in a spiral so as to be thrown out of the line of the long axis of the instrument (fig. 451).

Fig. 451.

Filiform bougies (the tips only).

With a number of such instruments used singly or many at a time, so that the points of some of them may engage in false passages and the mouths of dilated ducts of mucous glands, nearly every stricture, however tight, may by patience be overcome, and a guide thus passed into the bladder. Upon such a guide any instrument may now be safely passed, the instrument being tunnelled by having a little hole at its beak which is threaded over the guide. This use of tunnelled instruments is a great advance in modern urethral surgery. It was introduced to the profession several years ago by Prof. Wm. H. Van Buren, of New York, his then assistant, Dr. Gouley, whose name is sometimes given to these instruments, having carried out his designs by the aid of the different surgical-instrument makers. At present, greatly to their advantage, nearly all urethral instruments of small size are found in the shops tunnelled — the sound, catheter, and the various divulsors and urethrotomes.]

The influence of chloroform [or ether] has been sometimes found extremely useful in facilitating the passage of a catheter or sound through the urethra, especially when it is more than ordinarily sensitive, and the pain occasioned by instrumental interference produces uncontrollable and involuntary efforts of resistance on the part of the patient. It is to be remembered that it is not for the purpose of permitting the instrument to be used with greater force than before, but in order to produce relaxation of the muscular tissues, both of the voluntary and involuntary kinds, that the chloroform is administered; and it must, of course, be given to a sufficient extent to ensure this result.

Continuous or permanent dilatation.—A very useful means of rapidly dilating a stricture which has been obstinate under ordinary treatment is that of retaining the catheter in the urethra for forty-eight or seventy-two hours at a time, without removing it. Especially when great difficulty has been encountered in its introduction, this treatment is frequently of great value; if, owing to extreme sensibility, each introduction of an instrument is followed by much pain or by rigors, it is sometimes one of the most efficient methods which can be adopted. In putting it into execution, a week or two of confinement to the house must be reckoned on. The catheter having been introduced, it may be fastened by bandages round the body; for this purpose one may be carried round above the hips, another is connected with this, on each side, near the crest of the ilium and passed under the thigh, returning again to the crest, and then made fast. The catheter is then secured by a piece of narrow tape to the bandage on each side near the tuber ischii. A peg of wood is fitted to the orifice of the catheter, or better still, a piece of India-rubber tubing attached, with the other end in a suitable vessel. Or if it be a gum catheter, it may be attached to a piece of plaster lightly encircling the penis.

In the management of this process, three points should be attended to: first,

the catheter when tied in should not project into the bladder, or at any rate but very slightly; the proper distance is readily ascertained by observing the flow of urine through it, and drawing the instrument outwards until the stream just ceases; a very small portion only of the catheter can then remain within it. Secondly, if the first catheter passed has been a silver one, the succeeding instrument should be of gum-elastic, as causing less irritation, indeed rarely any, while the process of dilatation is quite as efficient as when metal catheters are employed. Thirdly, in no case should an instrument be permitted to remain in the urethra which fits tightly in the stricture; more real progress will be made by always using a catheter which lies loosely in the canal, than one which is large enough to be grasped by the contracted portion, while in the latter case irritation is liable to be caused, which may produce unpleasant consequences. During the period of remaining in bed, the patient may sometimes take a little hyoscyamus or opium, if pain or irritation render it necessary. The latter may be given in the form of suppository; but this is rarely necessary if proper care is taken in the management of the catheter, which is the most important part of the treatment. If, however, blood appears in the urine, or fever, or swollen testicle, the catheter must be withdrawn at once.

Usually, in about thirty-six hours, a purulent discharge is seen around the instrument, which soon becomes loose in the canal, although when first introduced it may have been firmly retained by the stricture. It may then be replaced by another two sizes larger, which will probably enter easily. In a day or two a similar advance may be made; and if all go well, the progress may be continued for five or six days; the patient sitting up daily for a few hours, if the gum-catheter is employed. If he is fatigued, a day or two's rest may be given, and the plan resumed if necessary. When a full size has been reached, the catheter is to be withdrawn, and an instrument passed daily for a few days, gradually increasing the interval, but endeavoring to retain as much as possible of the calibre gained; a certain degree of recontraction at first, however, is always met with.

Mechanical apparatus for effecting dilatation.—Among various forms of special apparatus may be noticed a method adopted by Mr. Thomas Wakley, which consists in sliding tubes over a small urethral guide first passed into the bladder; so that if the route is at first correctly taken, all the other tubes will follow the same course. Different methods of using sliding tubes were formerly adopted by Dr. Buchanan, of Glasgow (1831), Dr. Hutton, of Dublin (1835); by Desault (1797), and Maisonneuve (1845). The attempt has been frequently made to dilate a stricture by means of a single instrument which expands *in situ*, in the place of several instruments of increasing calibres which require to be successively pushed through the constricted part. With this object Mr. Luxmoor (1812) employed diverging metal rods; Leroy d'Etiolles the same method, some years later; and M. Perrève a somewhat similar plan (1847); Dr. Arnott commenced the employment of fluid expansion (1819). In a lesser degree, the accomplishment of the same object has been attempted by the use of catgut bougies, and very recently by bougies of laminaria, a species of seaweed which expands in contact with moisture. A German surgeon formerly, and Reybard, of Lyons, more recently, have employed metallic expanding instruments for the same purpose; although the latter chiefly employed such instruments for maintaining apart the incisions after urethrotomy. But he proposed this method also for effecting dilatation by progressive steps, with the view of carrying it to a higher degree than could be attained by any instrument the extent of whose expanding power is limited by the size of the external meatus, which is well known to be the narrowest part of the urethra. More recently, Mr. Holt has adopted the method of forcible rupture by means of an instrument precisely similar to that of Perrève, and has operated many times with success, and a greater freedom from serious consequences than would generally have been supposed, since he ruptures the stricture with considerable force.

In considering these, and numerous similar means which have been employed, it is impossible to forbear remarking that, for simple dilatation, not rupture, complicated apparatus is not so efficient or so desirable as the employment of a simple bougie, when passed with gentleness, and with a light hand. Were catheterism simply an affair of overcoming mechanical resistance, the expedients of the engineer would naturally commend themselves; but we must remember that, in the prosecution of dilatation, where the object is to avoid producing lesion, the delicate tube of the urethra and its important connections are to be treated as tissues endowed with vital functions and relations of the highest importance.

On the other hand, it is a remarkable fact, which I have now completely verified, that while an old and obstinate stricture may be dilated up to a certain moderate degree, beyond which the

slightest advance sometimes produces severe constitutional symptoms, the same stricture may be ruptured at once up to the natural calibre of the urethra without

Fig. 452. Fig. 453.

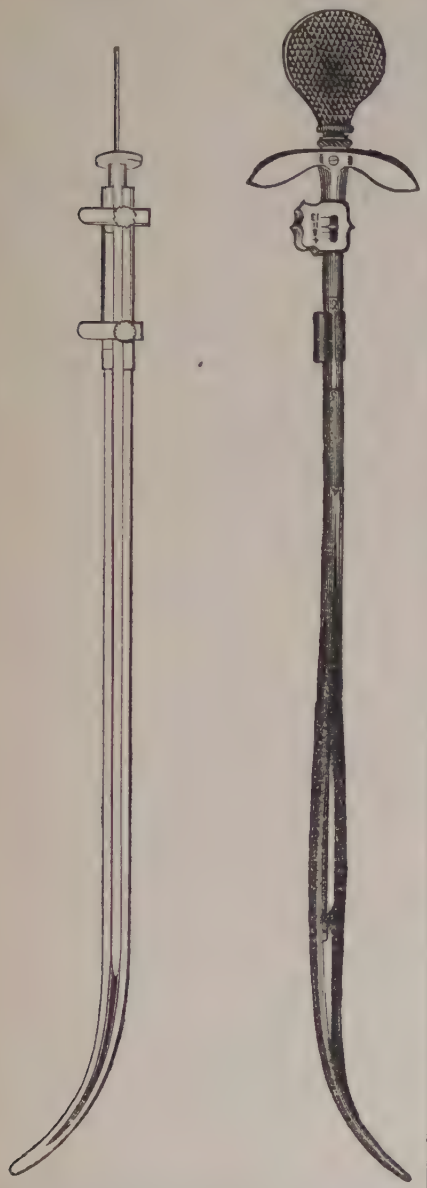


Fig. 452.—The instrument employed by Mr. Holt.
Fig. 453.—Distending instrument [Thompson's]; the blades are opened to the full extent. The index is seen just below the handle [see p. 798.]

any such symptoms. I have seen this as the result of Mr. Holt's method, and also from the use of an instrument employed by myself, which distends the stricture to a calibre of 14 or 16 of the catheter-scale. If, however, forcible dilatation be applied to an old and rigid stricture, after the method in vogue thirty or forty years ago (Mayor), that is by driving a large conical metal bougie through the obstruction, severe symptoms are almost infallibly incurred. Force so employed, and not exerted from within outwards as in the distending instruments referred to, pushes the stricture down the canal, loosens its cellular connections, and infallibly produces inflammation and fever.

Mr. Holt describes his mode of operating as follows: The instrument "consists of two grooved blades fixed in a divided handle, and containing between them a wire welded to their points, and on this wire a tube (which when introduced between the blades corresponds to the natural calibre of the urethra) is quickly passed, and thus ruptures or splits the obstruction." Having introduced it, and "reached the bladder, the dilator should be gently rotated, to prove that it is fairly within that viscus; and being thus assured, the surgeon is next to place the point of the tube he had previously selected upon the wire between the blades, and thrust it quickly onwards to the end. The stricture being now fairly split, the dilator should be rotated, to still further separate the sides of the rent, and then be withdrawn; a catheter corresponding to the number of the tube being substituted for the purpose of removing the urine."[1] The catheter is then removed, the patient treated with quinine and opium for the first twenty-four hours; and the same catheter introduced in forty-eight hours; and again on alternate days for a week or two, gradually lengthening the interval.

We are under obligations to Mr. Holt for perseveringly pursuing his practice by rupture, by which the remarkable facts previously referred to have been demonstrated. I do not hesitate to say, that many of the cases which have hitherto resisted dilatation may be successfully dealt with by that method, whether applied in his manner or by my own. The cases in which these methods appear most likely to be valuable are those in which the morbid material constituting the stricture does not form too thick or dense a mass to be entirely ruptured. Where the stricture forms a large and hard nodule, it is, in my opinion, beyond all question better to divide it with a cutting instrument. For some, however, of the cases which have been hitherto so treated, I believe the plans in question offer advantages. To rupture a stricture appears at

[1] The Immediate Treatment of Stricture. B. Holt. London, 1861, p. 7.

first sight a harsh and rough proceeding; but a careful and unprejudiced examination of its results on a large scale, and some personal practice of it, has convinced me that it deserves the character accorded to it here.

The plan which I have adopted is as follows: The instrument consists of two long and narrow steel rods, accurately applied to each other, but both forming when closed a cylindrical instrument the size of No. 3, 4, or 5. These rods are united at each end and throughout four inches of the shaft, and are surmounted by a handle containing a screw, which when turned causes the rods to diverge from each other very slowly and gradually, at a given spot, forming a spindle-shaped figure three or four inches in length, and the third or half of an inch in diameter. There is an index near the handle which shows the exact degree of distension made, by pointing out that number of the catheter-scale which is reached, as the operation proceeds (see fig. 453). The reason for carrying distension beyond the size which the meatus of the urethra will admit, is the fact, too often overlooked, that the great majority of strictures, that is, those situated at or near the bulbous portion of the urethra, occupy a part of the canal which naturally possesses a calibre of at least 16 or 18 of the catheter-scale, and that ordinary dilatation up to No. 10 or 12 inefficiently acts upon them. The method of applying the power by this instrument differs materially from that in others, in being made very slowly (better therefore under the influence of chloroform [or ether]), so that from seven to ten minutes are occupied in slowly reaching the maximum point of distension; the object being to overstretch the morbid tissues as much, and to rupture them as little, as possible, in order to destroy, or at all events to greatly impair, the natural tendency of the stricture to contract. Before operating, the distance of the stricture from the external meatus is measured by passing a full-sized bougie down to the stricture; the slide is then placed upon the figure on the stem which denotes that distance. The instrument is passed until the slide arrives at the meatus, and the blades are slowly separated: when the maximum distension is reached, the screw is turned back only about half-way, so as not to close the blades; the instrument is withdrawn; a full-sized gum catheter is at once passed, and allowed to remain twenty-four hours. On the third day after the operation a large metallic sound is passed, and subsequently at longer intervals. The instrument may also be used rapidly to produce rupture if preferred.

[It may with justice be doubted whether any use of this divulsing instrument is of value which does what its author proposes—dilates as much and tears as little as possible. On the contrary, my experience, embracing a large number of operations, inclines me to believe that only by rupturing the morbid tissue can the operation of divulsion be of service. Hence the more rapidly the instrument is screwed up the better it acts. A resilient stricture, as happened once in my experience, may be slowly stretched without rupture to a size as large or even greater than that of the normal urethra at the strictured point, and yet upon withdrawing the divulsor a very small instrument passed through the stricture may be grasped and tightly held, proving that the morbid narrowing, notwithstanding its overstretching, has not been in the least overcome. The instrument I use has been made of extra size, so that it may be screwed up to size 36 French—in case of need, and it is tunneled, so that it may be carried through the tightest stricture over a whalebone guide. My practice is to screw up the instrument rapidly without the use of chloroform, and to expect to see blood flow from the meatus, and sometimes to feel the rupture as the tissues give way. It is desirable to divulse up to a size two or three numbers higher than the sound which the surgeon hopes ultimately to employ. It is very rare for bad results to follow this operation, which is most applicable to deeply-seated tight strictures. It is better than internal urethrotomy, only in that hemorrhage is not to be feared as much from lacerated as from incised tissues.]

To return to the subject of gradual dilatation, and particularly to its employment for old and irritable strictures: in such cases, especially when occurring in enfeebled constitutions, it is necessary to proceed with great caution. More progress will often be made by employing those adjuvants, which a deranged state of the constitution requires, than by pertinaciously continuing the use of the bougie when the stricture is unusually obstinate; this is a maxim of the first importance. Further, having arrived at any given number in the scale, say 6 or 7, beyond which it is difficult to proceed, we may sometimes gain ground by employing half or intermediate sizes, which I have been in the habit of thus using for many years. Or we may employ the French scale, which gives 18 numbers between our numbers 1 and 12, and so admits of more gradual steps in the treatment; the number 3 of the French scale equalling our number 1, and the 20 our number 12; these have the advantage of indicating the exact calibre of the urethra through

which they have passed, the number of each indicating so many millimetres of circumference.

There are some cases unquestionably in which—however much of pains and care, of adjuvants local and general, have been expended—the patient's existence is barely a tolerable one. The urethra and bladder are so sensitive, or the stricture is so contractile, that exquisite suffering from instrumental interference, and fever, or retention of urine constant or constantly impending, are the alternations presented. These facts, recognized by all surgeons of experience, have led to proposals to treat the malady by many other methods. The next to be considered is the treatment by caustic agents.

1. *Caustics.*—During three centuries at least, escharotic substances have been employed by surgeons for the purpose of destroying the obstructions, in earlier times supposed to be "callus" or "caruncle," which oppose the passage of the urine. With this view, savin, antimony, mercury, verdigris, quick-lime, vitriol, alum, and other active agents have been carried by some contrivance or another down to the urethra. John Hunter, in the latter part of the last century, brought into note the nitrate of silver; and Mr. Whately, in the commencement of the present century, the caustic potash. These substances have been supposed by their advocates to act, first, by deadening sensibility, and thus allaying spasm; secondly, by causing to slough, and so destroying, the morbid tissue of the stricture itself; and lastly, by dissolving or softening that tissue, and thus permitting instruments to be passed. A very considerable experience has been obtained by some English and many French surgeons, the result of which is, that the practice of applying chemical agents has been for some considerable time steadily diminishing in the hands of the best surgeons. It has been very generally doubted if it be possible to limit the application of any soluble substance possessing the active qualities of those two agents, especially those of the potassa fusa, to any given portion of the urethra, particularly in those cases which are complicated with false passages, and which furnish by far the most difficult examples which the surgeon is called upon to treat. Their use also is by no means free from painful and even dangerous results, such as violent spasm, retention, and fever. Moreover, there is reason to believe that these caustics exert an action upon the urethra similar to that which follows their application on other parts of the human body, and liable to be followed by increased induration, and the formation of fresh contractile tissue. On the other hand, the advocates of potassa fusa especially claim, that after its use the catheter is more easily passed; and, that in cases in which they have been unable to pass any instrument at all, this agent has frequently been successful: while numerous results of this kind may, they say, be referred to. Now, it may fairly be granted as probable that a certain present advantage may be gained by the method in question, and that in this manner it may in some hands be undoubtedly useful; the remoter effects, however, already alluded to, should not be lost sight of; nor should the very important consideration that, by patience, care, and gentle management, there are very few cases indeed in which a catheter of some kind cannot be introduced fairly through the stricture into the bladder; a result far more desirable than any which is only accomplished by means of caustic applications. The conviction gains ground, both here and abroad, that those cases which have been called "impermeable," in relation to catheterism, should very rarely be considered so. Perhaps the opinions and practice of the profession abroad, in reference to caustics, cannot be more truly or concisely represented than in the recent words of Nélaton, who states that "cauterization of any kind is rarely employed now, on account of its uncertainty and the tumefaction of the urethra and retention of urine which it produces, and the new formation of contractile tissue which is likely to result."[1] In like manner, the widely received opinion in England is thus expressed by Mr. Erichsen: "This practice, stigmatized by Mr. Liston as 'most atrocious,' has now but few advocates; and, indeed, there appears to be nothing that it effects but what can be accomplished much more safely and easily by a catheter or sound in an ordinarily skilful hand."[2] It may be added, that my own observation and experience lead me fully to coincide with these able surgeons.

Under such circumstances, little need be said here as to the method of employing these agents. It suffices to state that the nitrate of silver may be applied by passing a small stilet, on which the salt has been fused, by means of a hollow canula down to the stricture, with which the agent is permitted to remain in contact for a few seconds. The potassa fusa is ordinarily employed by carefully attaching a small fragment, such as the fourth or the half of a grain, to the end of a wax bougie, and then passing it down and pressing it for a moment or two against that structure, whatever it may

[1] Élémens de Path. chir., Paris, 1858, tom. v., p. 409.

[2] Science and Art of Surgery, 7th edit., Philadelphia, 1878, vol. ii. p. 862.

chance to be, which stops the instrument in its progress along the urethra.[1]

2. *Incisions.* — Under this somewhat comprehensive term are included numerous modes of dividing the morbid structure which surrounds and narrows the urethra. All may be arranged in two classes: the first contains operations in which the incision is made altogether within the urethra; the second, those in which incisions commence from without, usually in the perineum, and are carried into the urethra and through the seat of stricture.

The first, or internal urethrotomy, will now be considered. This method of dealing with obstinate stricture has been practised for above a century. Long before that time, internal incisions had been combined with the use of escharotics, although it does not appear that they were employed alone much before the period named. Allies, of France (1755), Physick, of Philadelphia (1795), John Bell (1806), Charles Bell (1807), M'Ghie (1823, and Stafford (1827), have employed different instruments and different modes of performing internal incision. Modified forms of some of these have been occasionally adopted by modern surgeons in this country; but the method has been practised much more extensively in France, where very numerous forms of urethrotome have been designed.

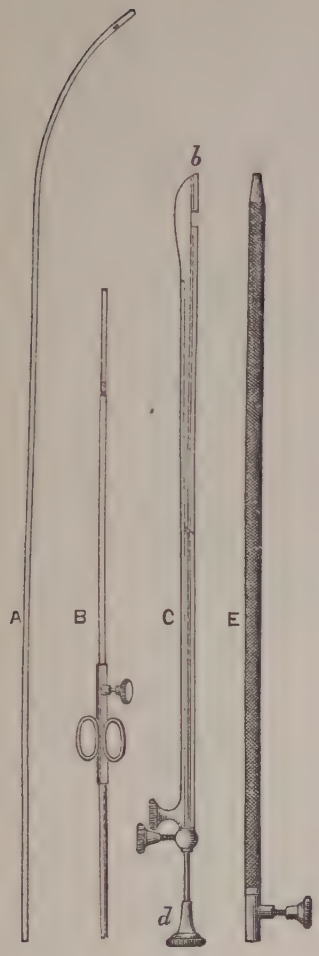
All belong to one of two classes: in the first, section is made by pushing downwards a lancet-like blade, generally with a slender conductor in advance of it, into the obstruction to be divided—incision from before backwards. In the second, a portion of the instrument containing a small blade, sheathed, is first carried through the stricture, which is divided by protruding the blade and drawing it outwards through the whole of the contracted portion—incision from behind forwards.

Incision from before backwards.—Whenever this mode is practised, a guide should previously be passed through the stricture into the bladder, to insure an accurate course for the blade: formerly incisions were made without any guide—a method now wholly discountenanced, on account of its uncertainty and danger. This proceeding has usually been considered more applicable to obstinate strictures which are situated within three or four inches of the external meatus, provided they are not greatly indurated, than to those which are more deeply placed, although it is quite possible, especially with modern instruments, to employ it for these also. It has not been greatly used in this country, but has of late come more into vogue abroad, from the recent employment of a fine flexible guide, which precedes the urethrotome in its passage through the stricture and is then pushed onwards into the bladder. The practical value of this method cannot be endorsed here: a better one, with a grooved guide, has been employed by Mr. Wood, of King's College Hospital; and more lately a "catheter urethrotome" has been designed by the present writer, "the peculiarity of which is that every step of the process is mechanically certain and safe, after a No. 2 catheter has been passed." The catheter having withdrawn the urine, and thus proved that the instrument is not in a false passage, the blade slides along it through the stricture, is then withdrawn, and a large gum catheter is passed over the small silver catheter, which, being also withdrawn, concludes the operation (see fig. 454). This remains for twenty-four hours; and the subsequent treatment is the same as that described in the next section. More recently an instrument has been devised which bears the name of Trélat, of Paris, more efficient, perhaps, than any of this kind which have preceded it, inasmuch as it may be used not only from before backwards, but if, after such an incision, a second is necessary, it can be made from behind forwards, and with augmented power (see fig. 456.)

Incision from behind forwards.—Nevertheless this mode of operating is for the most part more certain and effective than the preceding; and it is applicable equally to all parts of the canal. It requires generally, however, that the stricture should be dilated sufficiently beforehand to admit that part of the urethrotome which contains the blade to pass through and beyond, before the incision can be made; and this portion is necessarily equal in size to No. 3, 4, or 5. This preliminary dilatation is accomplished by the "continuous" process. It has often been objected that if we can pass a No. 4 or 5 through a stricture, there can be no occasion to employ any cutting instrument at all. But such a remark is based upon defective acquaintance with the subject. The indication for a cutting operation is not that the *stricture is of very small calibre, but that it is non-dilatable;* that is, that its calibre cannot be permanently increased by the most persevering and judicious application of instruments, or that so much fever and distress are produced by them as to counterbalance the benefit of any dilatation they may effect. Thus a stricture may at the outset of treatment not

[1] Further information on this subject, if required, may be found in the works of B. Phillips, who first advocated and subsequently repudiated the employment of caustic; of Dr. Jas. Arnott, Mr. Wade, and Mr. H. Smith.

Fig. 454.



A, silver catheter, size of No. 2, by which the urine is withdrawn. B is a rod of the same size, which screws into the end of the catheter. C is the urethrotome; *b* the blade sheathed; *d* the handle which unsheaths it. This instrument passes down a groove in A, and after incising the stricture, is withdrawn; when E, a gum-elastic catheter, is passed into the bladder over the catheter and rod, A B.

Fig. 455.

Civiale's urethrotome.

Fig. 456.

Trélat's urethrotome.

admit even a No. 1 bougie, yet in a short time it may be easily dilated, and show only slight tendency to return, easily counteracted by occasionally passing an instrument; on the other hand, a stricture which habitually admits No. 6 or 7 may be the cause of the greatest suffering, almost daily retention, and be irritated instead of benefited by all attempts to dilate. It is in such cases, happily not frequent, that incision has proved of very great service. I have rarely experienced better results from any operation than those obtained from internal urethrotomy in cases of the kind described.

Before employing any form of internal urethrotomy, it is necessary to have an

accurate idea of the site and extent of the stricture to be divided; this is obtained by employing on two or three occasions a solid sound with a bulbous extremity, just large enough to pass through the contracted part (p. 791).

I have employed by choice the urethrotome of Civiale,[1] and to the present day (1870) I prefer it to any other. In this instrument the blade lies concealed in the bulbous extremity, from which, by means of a simple contrivance in the upper end of the sheath or canula, it can be made to project one, two, three, or four degrees, according to the depth of the incision intended (see fig. 455). The mode of proceeding is as follows: having sufficiently dilated the stricture, so that it will admit about a No. 4 or 5 bougie, the situation and extent of the obstruction are ascertained by means of the urethrotome itself, the bulbous end of which forms a useful sound. The bulb is then carried about one-third of an inch, or a little more, beyond the stricture, the blade projected, and the incision made by drawing it slowly but firmly outwards—that is, in a direction towards the external meatus—to the distance of an inch and a half or two inches, generally towards the floor of the urethra, so as to incise fully the stricture and a little of the sound urethra before and behind it. Experience shows that hazard is not increased by the length of the incision, which should always be fully adequate to the purpose; but it is quite otherwise in the important particular of depth; this should never exceed the amount produced by about half the power of projection possessed by the instrument in question. It is not an unwise proceeding to pass immediately after the incision the dilating or distending instrument to the fullest size, so as to insure the perfect freedom of the canal at all points. After the operation, a full-sized elastic catheter is retained for twenty-four hours. During the first fortnight, a metallic sound is passed about every second day, taking care to press the convexity of the curve well downwards into the site of the wound, so as to keep the lips asunder, or at all events to extend the cicatrix. After this it is to be used every three days, every four, every week, and at last twice a month. Hemorrhage to any considerable extent is rare; if it is free, a full-sized instrument in the urethra, and external cold, will stop it. Febrile symptoms occasionally show themselves after the operation, as in other modes of treatment, and disappear without remedial means. In relation to the accidents which may immediately follow the operation, the following is the result of perhaps a hundred cases of urethrotomy performed by myself in the manner described. In those practised for stricture situated in the urethra in front of the scrotum, I have seen no ill effects whatever. In those practised in the bulbous part of the urethra, I have twice seen free but never dangerous hemorrhage; and sometimes a smart attack of fever, but never abscess, extravasation of urine, inflammation of the bladder or kidneys, or pyæmia. Such occurrences may occasionally be met with, doubtless, because any instrumental interference with the urethra—even the passing of a bougie—is apt in certain cases, happily very few in number, to give rise to these conditions. Indeed, no one who is experienced in the surgery of the urinary organs can question that such events must sometimes arise.

In relation to the positive benefits which are to be obtained, the immediate result is perfect. Properly incised, there is no longer the slightest grasp on the largest instrument introduced, and it is often difficult to recognize the seat of the former contraction.

In some cases these results are permanent; in others, the stricture shows a tendency to return; but as in external division, so in internal, the contractility and the non-dilatability—those characters which have been before shown to be the indications for resort to operative procedure—are generally greatly diminished in intensity; and if subsequent treatment be necessary, dilatation usually suffices.

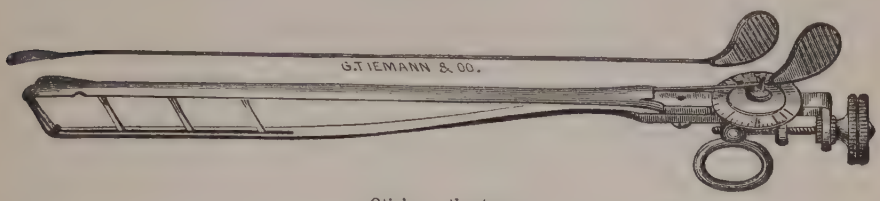
Such have been the general results of urethrotomy, when properly performed, and applied to suitable cases. I think it right, however, to add here, that my observation and experience of distension at a single sitting, or by rupture, have convinced me that we may thus produce excellent results at first, which, however, are often not durable; so that these methods will by no means supersede internal incisions. For all non-dilatable strictures situated from two to four inches from the internal meatus, I decidedly prefer internal urethrotomy; the operation is perfectly safe and easy to perform, and its results more lasting and complete than any other.

[Greater accuracy in the cutting operation may doubtless be attained by using one of the numerous dilating urethrotomes, than by employing Civiale's or any of the old instruments. For mechanical excellence in construction, and ease of accurate application in the pendulous urethra, I think no instrument so good

[1] Various other methods and instruments have been devised, by Amussat, Leroy d'Etiolles, Sédillot, Maisonneuve, Ricord, Mercier, Reybard, Heurteloup, Bonnet, Boinet, and others; but it is deemed unnecessary to refer further to them here.

as that of Prof. Otis, of New York (fig. 457). By accurately locating the position and extent of stricture with bulbous bougies, and using this instrument after its point of emergence of the knife has been introduced beyond the stricture, great accuracy of section may be attained with a little care, and the exact depth of incision

Fig. 457.



Otis's urethrotome.

graded with considerable nicety. Considerable hemorrhage follows the use of this instrument, sometimes. It is not customary, after the use of Dr. Otis's instrument, to leave any instrument tied in. The cut is kept open until it heals, by the occasional use of sounds.]

Incision is also especially applicable to that not uncommon form of stricture which occurs at, or very near to, the orifice of the urethra. It may be congenital, the result of inflammation, of cicatrization after chancre, or other lesion there. It may be the only obstruction in the canal, and yet give rise to the most painful and serious symptoms, and even to a fatal result. I have repeatedly given complete relief to distressing symptoms, the cause of which was not suspected, by dividing an external meatus, which admitted nevertheless a No. 5 or 6 catheter. The incision may be performed with a director, and a straight, narrow-bladed bistoury; but the most efficient instrument is a small *bistouri caché*, which is passed through the contracted part of the canal; pressure being made on the handle, the blade is opened to an extent previously determined and arranged by means of the screw; it is then drawn out, with the edge turned towards the frænum, and the section is made. A piece of dry lint, introduced by the meatus for an inch and left there, stops the bleeding. After a day or two, the patient introduces for himself a short conical metal bougie, about three inches long, and provided with a handle sufficiently large to prevent its slipping into the urethra.

The late Mr. Colles, of Dublin, adopted a method of treating some of these cases which deserves notice. It consists in drawing over the surfaces divided by the section described the two edges of urethral mucous membrane, and stitching them to the external margins of the wound, each lip of which is thus covered by membrane, and prevented from adhering to its fellow.

External urethrotomy.—The division of the tissue composing the stricture is sometimes effected by incisions commenced from the external surface. Various external operations, although designed mainly to relieve retention of urine, were made at a very early period, according to Rhazes (10th century), and Avicenna (11th century). The earliest operation for the cure of stricture apart from retention, but in which the surgeon could pass no catheter, is recorded by Wiseman (1652). A few years afterwards, Solingen, at Livourne, adopted a similar course. François Tolet and Colet (1690) appear to have performed similar operations in France. J. A. Petit and Ledran (1740) had recourse to them also, and more frequently perhaps than their predecessors. In 1783 John Hunter performed the operation now known, and described hereafter, as the perineal section; but it was rarely employed until Mr. Grainger, of Birmingham, advocated it, in 1815. He was followed by Mr. Arnott: since which time it has been the proceeding ordinarily adopted for the treatment of certain extremely obstinate and complicated cases, in which the surgeon has found himself unable to pass any instrument whatever through the stricture. More recently (1844), Mr. Syme has advocated the division of the stricture for some exceptional cases, in which, *although a catheter can be passed into the bladder*, no other treatment has afforded sufficient or permanent relief. This operation he has called "external division," a term which should be reserved for his method; while it is equally desirable to limit the use of the term "perineal section" to the proceeding just referred to in connection with strictures which have been found impervious to the catheter.

Perineal section will be first considered. This operation, or that without a guide, and employed only for so-called "impermeable" stricture, is much less frequently performed now than it was some few years ago. There is a growing belief, which has greatly influenced practice, that few, if any, strictures exist through which, if the urine issues externally, a catheter of ap-

propriate size may not be passed in the course of time, with care, gentleness, and skill. This opinion, after some years of experience of the treatment of stricture in its worse form, I entirely endorse; and have no hesitation in stating, as a general rule, admitting of very few exceptions, that no stricture permeable to urine is impermeable to an instrument, providing that that instrument is sufficiently small, and is used with the utmost gentleness and care. If, however, the surgeon meets with an exception to this rule, the following operation, which I may repeat I have had occasion to perform only twice, is considered admissible. The stricture being situated in the bulbous portion of the urethra, the patient is placed on a table, in a good light, is secured as for lithotomy, and the perineum is shaved. A large catheter is to be passed as far down the urethra as the obstruction will permit, taking care that the instrument rests on the face of the stricture, and not in a false passage; an assistant holds it firmly, and draws the scrotum upwards. An incision is made in the middle line of the perineum, along the raphé, from the base of the scrotum to near the margin of the anus, and the point of the catheter is to be exposed by deeper incisions. The sides of the opening are then to be held apart as widely as possible with hooks, better still by two loops of thread, one passed through each margin of the urethra at the point of obstruction as soon as the canal has been laid open so as to give a clear view of the urethra and of the contracted opening. This done, the operator, who should be provided with grooved directors of the smallest size, endeavors to carry one of them through the contraction, and if he is successful, the division may be made with ease and safety. He may not be able to pass the director more than two or three lines, until, having made a careful division so far, he may be enabled again to follow the track of the contracted canal, and to divide another portion of it upon the instrument. But if a director cannot be introduced, he must endeavor by dissection to follow the urethral canal as closely as possible. In either case, as soon as the continuity of the passage is restored, the catheter first employed is to be carried onwards into the bladder, secured in the usual manner, and retained for some days.

[There is certainly nothing to be gained by tying in a catheter, and this step in the operation may be omitted with advantage. The presence of the catheter is a source of discomfort, makes the patient more apt to have chill and cystitis of the neck, and cannot prevent the contact of urine with the cut surface, as this invariably occurs at the time of the operation. A full-sized sound, passed every third or fourth day, is all the surgery required, if the cutting has been complete. Patients after this operation often get up and go about on the eighth day, which they surely could not do had a catheter been tied in for several days.]

External division.—This proceeding consists in first passing a slender grooved steel sound through the stricture into the bladder, and in cutting down from the external surface to it, so as to divide entirely the stricture: then a large catheter is tied in for forty-eight hours, and dilatation maintained at intervals afterwards.

[A whalebone guide, over which a tunnelled catheter or grooved steel sound is passed, greatly facilitates the performance of this operation in difficult cases, while it renders it much more safe; it is undoubtedly better than Syme's staff. The remarks already made about tying in a catheter are as applicable to this operation as to the other done without a guide.]

The following are the details to be attended to in performing the operation: First, a clear idea of the precise situation and extent of the stricture must be formed before commencing. Next, the patient being placed as for lithotomy, a staff, the lower half of which is slender and grooved, and the upper of full size, is passed so that the shoulder or edge of the thick portion rests firmly against the face of the stricture, the slender part passing through it into the bladder. An assistant holds the staff in his right, and draws up the scrotum with the left, hand. The operator makes an incision in the line of the raphé from above downwards, about two inches long, and steadily follows the direction of the median line, through the structures intervening between the skin and the staff, until he can distinguish the shoulder of the staff, and by that is guided to the position of the stricture, when, taking a sharp straight bistoury in his right hand, and the staff itself in his left, he engages the point of the knife in the groove of the staff about an inch below the shoulder, and cuts upwards, dividing the tissues, to the upper end of the groove. If the stricture has been properly divided, the shoulder of the staff may be passed downwards through the incised part with ease, and if so, is withdrawn, and a catheter passed in its place. Since, however, the point of a catheter sometimes catches in the wound, and does not go readily into the bladder, perhaps from the urethra occasionally collapsing at the posterior limit of the incision, I prefer to introduce by the wound, before withdrawing the staff, a concave curved director along the convexity of the staff, on which the catheter glides securely and certainly into the bladder. If the catheter, however (which

should not be smaller than No. 10), be obstructed at any point, and be obviously grasped after it has been passed, it is certain that some fibres still require division, and these should be at once incised.

At the end of forty-eight hours the catheter is to be withdrawn; and generally about three days after a full-sized sound should be passed. Mr. Syme likes to guard the wound from contact with urine as much as possible, by introducing a tube from the wound to the bladder, and leaving it there, as after lithotomy; and he employs, in that situation, one with a double curve, and about nine inches long, instead of the catheter, which he dispenses with altogether at first. Subsequently the catheter is passed every three or four days for a time, then once a week, then once a fortnight, and finally once a month; and the practice may be continued if any disposition to contract appears; but if otherwise, it is necessary only to make a trial of it from time to time.

Mr. Syme lays stress upon the importance of attending to the following particulars, which I add briefly here: 1. Maintain the median line in the incisions. 2. Make a direct opening down to the staff, not a tortuous one. 3. Divide the whole of the contracted part, rather more than less. 4. Do not cut so far back as to endanger the deep fascia of the perineum, and use the knife in the deep incisions with the cutting edge uppermost. 5. Do not close the end of the inlying catheter, lest urine be forced into or through the wound, for want of patency in the instrument. 6. Avoid escape or displacement of the instrument. 7. If incisions are made far back, introduce a curved tube through the wound when the catheter is withdrawn. 8. Do not neglect dilatation during the progress of recovery.

Results of treatment by external incisions.—In reference to the operation without a guide, or the perineal section, the best that can be said of it is, that it is a hazardous proceeding, and no surgeon should entertain the idea of performing it except after thoroughly assuring himself that the stricture cannot be rendered permeable to instruments, and so made amenable to other modes of treatment. In a few cases the operation is performed successfully, but in most there can be little doubt that the route of the stricture itself is not followed, and that the knife makes a new channel through adjacent and often very unsound tissues, very inadequate to perform subsequently the function of a urethra. In many instances the attempt to make a channel to the bladder has wholly failed, and the patient has been removed from the operating-table unrelieved; and in not a few the result of the proceeding has been fatal. This termination, however, is to be anticipated in a large proportion of what must necessarily be the worst cases of their kind. Such views of this operation tend to impress us more strongly with the conviction, that every chance of getting an instrument through the dilated urethra, by protracted but gentle endeavors, combined with rest and constitutional treatment, should be exhausted, before we consent to resort to perineal section.

Respecting the operation of external division, or that performed on a grooved staff, it will be remembered that it is applicable only to cases which present an insuperable tendency to contract after dilatation, or in which the existence of intractable perineal fistulæ demands some such operation.

After a careful observation of a large number of cases so treated, there is ground for speaking with some degree of certainty respecting the immediate and remote results of this operation. Among 219 cases, collected with scrupulous care by myself, there was a mortality of between six and seven per cent. Of this percentage nearly two-thirds died of pyæmia, the remainder (one or two only excepted) from fever and suppression of urine. Such a mortality is by no means large when we consider what kind of subjects selected bad cases of stricture are, especially as they occur in hospital practice, by which most of this series was furnished.

Hemorrhage, to a moderate but not dangerous extent, not unfrequently occurs either at or after the operation. Very rarely is it serious; and when it is, there ought not to be difficulty in stopping it. A full-sized catheter being in the urethra, it is necessary to plug the wound with lint, and maintain a firm pad of the same material over it, by means of a T-bandage closely applied. In one case in which I operated, the perineum being greatly indurated, with several fistulæ, there was obstinate bleeding from vessels which the ligature would not hold, owing to the nature of the tissue in which their mouths were embedded; but I succeeded in stopping it by carrying a small curved needle beneath each bleeding point. In regard to the important question of remote results from this operation, there have been some few cases undoubtedly in which it has failed to be successful; in a much larger proportion, more or less recontraction appears after the lapse of time. This has sometimes arisen from want of care to divide the entire contracted portion of the urethra; in other cases, from neglect of subsequent dilatation. On the other hand, in some cases, I can personally vouch for the fact that no narrowing has appeared seven years after the operation.

In most, I believe, it will be always necessary, or at all all events prudent, to maintain some dilatation afterwards; the condition usually obtained being a dilatable urethra, in the place of a non-dilatable and obstinate stricture.

Spasm of the Urethra.

It is extremely rare that any considerable narrowing of the urethra takes place as the result of pure spasm of the muscles surrounding the passage. Granted, however, the presence of organic narrowing, or of inflammation in the canal, an undue action of the urethral muscles may be excited, so as still further to narrow it. There is no doubt that a slight degree of this action may be excited in any part of the passage; but it certainly becomes more obvious in the membranous part, where sphincteric muscles exist in addition to those unstriped fibres which surround the canal throughout the whole of its course. Nevertheless the existence of "spasm" is very constantly and very frequently affirmed, often without any proof of its presence, and usually in order to account for unsuccessful catheterism. Organic difficulties are quite sufficient without it, in many bad cases, to baffle at times the most experienced and most dexterous operator.

As immediate causes of spasm may be named the following: the presence of organic stricture; of inflammation from repressed gonorrhœal discharge; irritation of the mucous membrane from highly acid, and occasionally from acrid, urine; from foreign matters ingested, and expelled by the urine, as cantharides, turpentine, and perhaps some forms of condiments and of alcoholic drinks; and from voluntary retention of urine exerted during too long a period of time. Examples of more remote causes of spasm are rectal irritations, as hemorrhoids, fissure, prolapsus, fistulæ, operations in the rectum, ascarides, prurigo about the anus, derangements of the digestive apparatus and of the cerebro-spinal system. But it is important to remember that the distinguishing feature which marks the phenomena thus ascribed to irregular muscular contraction, and by which they are contrasted with those of organic stricture, is their transitory character. The symptoms of a narrowed urethra may repeatedly occur, but the canal ordinarily possesses its natural degree of patency. This is never the case in the presence of organic stricture; the stream then varies, but it never attains the natural size.

[Verneuil, and Folet, in France, and Prof. Otis, of New York, have pushed the theory of spasm as an agent in producing the symptoms of stricture to what conservative surgeons consider extreme limits. The general conclusions of these gentlemen seem to be that stricture is very common in the pendulous urethra and quite uncommon in the deeper parts of the canal; many so-called deep strictures being merely spasm of the deep urethra entertained more or less in permanence by conditions of irritation situated elsewhere and acting in a reflex manner upon the deep urethra. The most common of these irritations is believed to be a stricture or strictures of the pendulous urethra—after the division of which it is asserted the spasm of the deep urethra subsides.

There is a measure of truth in all this which Civiale recognized long ago. Undoubtedly there is more truth in it than some surgeons will allow, but there certainly is not so much as those who are attempting to vulgarize the theory claim. The practical outcome of the whole discussion is that anterior strictures should be looked for and carefully treated before deciding about a deep stricture in cases of doubt, while the possibility of prolonged deep urethral spasm must not be overlooked.]

In treating spasm, general principles must be kept in view, and applied according to the particular requirements of each case. Local treatment of the urethra itself is often of secondary importance, sometimes, indeed, prejudicial. The main thing, as in all spasmodic affections, is not to regard so much the sign or symptom itself as to investigate the cause, a correct appreciation of which is the only key to successful treatment. This must be carefully sought, not only in the urinary tract, but in adjacent and allied organs, and in the condition of the system at large. Speaking in general terms, it will be found that attention directed to the condition of the animal powers, to the improvement of the secretions, and to the regulation of the regimen and habits of the patient, will conduce more to the removal of the local symptoms than any measures apparently of more direct or special application.

If any degree of organic stricture coexists, it is essential to treat this in the usual way; but as far as the complication of spasm is concerned, the treatment consists in obviating all sources of derangement which can be discovered as likely to influence the condition of the local disease.

I have known a single instance of spasmodic retention to occur periodically, and to disappear before the use of quinine: Sir B. Brodie records one similar case. A very hot hip-bath, a cupping on the perineum, or the inhalation of chloroform

may sometimes give instant relief. For the most part, however, spasmodic action in the urethra is associated with inflammation affecting a part or the whole of the canal, and especially when inducing retention of urine. Any further notice of its treatment will therefore be referred to the management of that condition. (See Retention of Urine, p. 811.)

Inflammation.—Retention of urine is undoubtedly caused by inflammation of the urethra; but this is by no means inflammatory stricture in any sense in which the term can be logically employed; the pathological condition usually present in such cases is acute inflammation of the prostate, with swelling of that gland (see p. 784). The patient complains of heat, fulness, and tenderness in the perineum; the passing of the urine is exquisitely painful; the stream narrows rapidly during the act of passing it, and ceases before the bladder is emptied or the desire dimifiishes. Usually it is found on inquiry that a recent purulent discharge from the urethra has been suddenly checked by external cold or wet; the signs of inflammatory fever are usually present. As this condition almost invariably comes under the surgeon's notice for relief of retention of urine, the subject of treatment will be considered in the section devoted to that condition resulting from acute prostatitis.

Tumors in the urethra.—The cause of urinary obstruction was formerly supposed, in nearly all cases, to be the existence of "carnosities or caruncles" growing from the mucous membrane of the urethra. Such bodies do exist, but they are excessively rare.

Pascal (1718) describes two cases of numerous small fungoid excrescences obstructing the urethra. Morgagni (1761), in his forty-second letter, speaks of one which he had seen among many examinations. Arnaud (1769) names three instances. Hunter met with two cases; one is in the Museum of the Royal College of Surgeons. Sir Charles Bell describes and figures two cases. Amussat, Civiale, Lallemand, Ricord, Chelius, Leroy, and Mercier, all describe occasional cases met with in their own individual experiences. Guthrie and others in this country have met with a case occasionally. A good specimen exists in the Museum of Guy's Hospital of polypoid growth springing from the mucous membrane of the membranous portion. I have myself met with a good example of small polypus springing from the verumontanum, in a man, aged fifty-four years, a patient in the St. Marylebone Infirmary. The only sign of its existence, which could be ascertained during life, was an increased frequency of micturition. Those which are found at the anterior part of the canal, and which appear almost confined, as regards situation, to the fossa navicularis, are usually soft, of a rose-red color, bleed very readily, and are not very sensitive. Their close proximity to the erectile tissues beneath may be reasonably supposed to be the cause of their peculiar vascularity. That they are, but more rarely, to be found in the posterior parts of the canal, is proved by some of the preparations referred to. On the other hand, almost all the specimens of the polypoid growths which I have seen are confined to the prostatic portion, and are sometimes accompanied by others at the neck of the bladder or within it, to which latter, indeed, they then have the appearance of being secondary formations, and they are more frequently found affecting only the lining of the bladder, and not that of the urethra at all. In such cases their structure amounts to little more than hypertrophy of the mucous membrane.

The conclusions to be drawn from the facts known respecting growths into the urethral canal are:—

First, that the existence of any excrescence so large as to attract observation as an independent growth in the urethra is extremely rare.

Secondly, that these bodies consist either of (*a*) *vascular granulations;* (*b*) *polypoid formations* peculiar to the prostatic part of the urethra; or (*c*) masses of *tubercular* and *cancerous* origin.

Lastly, that tubercular and cancerous deposits are rarely primary in the urethra, but are mostly secondary to disease of the kidney, bladder, or prostate, and rarely appear until the primary disease has been developed to a formidable extent elsewhere.

Urinary abscess—most frequently a result of obstruction in the urethral canal—may be regarded in reference to its situation as penile or ante-scrotal, scrotal, perineal, and intra-pelvic. Among these the perineal is the most common, next comes the scrotal; the intra-pelvic occurs usually in very advanced cases of stricture, etc., in which a fatal result is impending, and also as a consequence of operations; and the penile is rare, most frequently being caused by gonorrhœal inflammation of the urethra.

Occasionally, but by no mean commonly, urinary abscess in the perineum may be met with, when there is no obstruction in any part of the urethra. When this is the case, there is some ground for suspecting that disease exists at or near the neck of the bladder, particularly disease of the prostate. In chronic suppurative disease of that organ, perineal abscess sometimes appears.

Ordinary urinary abscess in the perineum may be acute or chronic: the former usually requires prompt interference on the part of the surgeon, and its presence is often indicated by constitutional symptoms before local evidence appears of

a marked character. If these are severe, and there are also tension, fulness, and tenderness in the perineum, a free and deep incision made in the middle line will often give instant relief; and if matter is not seen at once, such a proceeding will do no harm, although nothing else result but a little bleeding, and the relief of tension. No considerable hemorrhage need be feared, although sometimes, when there has been much inflammation in the part, a smartish trickling may continue for some little time. When it has ceased, a poultice should be applied to the wound. Great improvement in the patient's condition often takes place almost immediately; the fever subsides, and complete recovery may follow in a very short time.

The importance of speedily evacuating such collections of matter, even at the commencement of their formation, cannot be overrated. Matter pent up behind the deep perineal fascia, which forms a partition too dense to be penetrated by the action of absorption, will find its way into the cellular tissue of the pelvis, by the side of the bladder, between it and the rectum, and give rise to dangerous consequences, or in event of recovery, to urethro-rectal or vesico-rectal fistulæ. Otherwise it may burst into the urethra, and be discharged by the external meatus. The collection having been opened, pus in some quantity escapes, usually alone, sometimes mixed with urine, but not necessarily so. One of the main objects in making an early opening into a collection of matter in the perineum, is to prevent the occurrence of any lesion of the urethral walls; if its evacuation be soon and fully insured, we may hope to find the cavity gradually closing, and that no urine will penetrate it, when there will be less fear of its remaining long open, or of its becoming an abnormal passage for the urine.

In the case of chronic abscess, it is desirable that an incision should be made when the presence of matter is perfectly evident. These abscesses are usually situated in the neighborhood of the bulbous portion of the urethra, and appear in the perineum and scrotum; sometimes as the result of a little ulceration behind the stricture, and escape of a drop or two of urine into the cellular tissue; oftener, perhaps, from the adjacent irritation, without having any direct communication at first with the urethra. This communication almost invariably takes place if the abscess breaks of itself, sometimes when it is opened by the lancet; but generally no urine appears when it is opened early, until some days after the operation, and occasionally not at all. An unnatural opening, however, having been established, the frequent passage of the urine through it, which must occur at each act of micturition if the stricture be narrow, prevents its closure. This artificial canal, usually termed urinary fistula, is one of the common accompaniments of neglected stricture, and often forms a troublesome complication.

Urinary fistulæ.—The external openings of these passages are most commonly seen in the perineum and scrotum, which are traversed by them in various, and often circuitous, routes; less frequently they are observed in the groins, the upper part of the thighs, the adjacent parts of the nates, or even above the pubic symphysis. In the last-named situation, the devious channel usually results from incisions made to relieve extravasation; but in the scrotum or perineum it is generally due to a previously existing urinary abscess.

Under the term "urinary fistulæ" all these conditions are commonly included; some of them simple, and easily amenable to treatment; others complicated, and requiring much care and time in order to attain a successful result. Some are merely narrow channels through nearly healthy parts; others pass through structures indurated and deformed by repeated deposits of plastic matter, and sometimes connected with cavities secreting pus, and detaining in their interior some quantity of the urinary secretion. The external orifices of the fistulous passage may be few or numerous; being in the latter case the outlets of sinuous channels springing from the original track, and giving exit to a number of small streams when the act of micturition is performed. And lastly, besides the foregoing, there are those openings into the urethra which have their origin in loss of substance by sloughing from extravasation, phagedænic ulceration, or violent injury to the parts; and these abnormal conditions are distinct in their nature from the two preceding classes. This mode of arranging the numerous and widely-differing lesions comprehended under the general term urinary fistulæ, indicates three forms of morbid condition, each requiring appropriate treatment.

1. Simple fistulæ. The first class embraces those cases where, in connection with stricture of the urethra, one or more fistulous passages exist, the surrounding parts being not much altered from their natural or healthy condition. These openings are the result of nature's mode of affording relief in cases of narrow stricture; they act as safety-valves to the pressure exerted upon important organs behind the obstruction. Thus we often see patients enjoying fair health and comfort, notwithstanding large fistulous passages in the perineum, by which all their urine is passed. But the annoyance,

sometimes the pain, besides the tendency to grow worse, which accompany urinary fistula, to say nothing of considerations arising in relation to the sexual function, demand the interference of the surgeon to bring about a natural state of things.

For these cases, as a rule, nothing else is required than to dilate fully the urethra. The urine will flow by the natural channel, and the fistulæ will heal of themselves, if we insure a free passage from the bladder. Those patients who form the exceptional instances to this rule are for the most part weak in constitution, have little reparative power, or are subjects of some chronic disease in addition to stricture of the urethra. The management of these is mostly that of the next class.

2. Cases in which the fistulæ pass through tissues indurated and deformed by inflammatory exudation.

In these cases also, the primary object is to dilate adequately the stricture, and to observe the effect induced. In some of them it is sufficient to enable the fistulous passages to heal slowly. Dilatation, however, having been maintained for some time, and little or no benefit having resulted, it will be desirable either to stimulate the walls of the fistulæ themselves, and so bring about adhesion of opposing surfaces; or to lay them open, in order to produce recent and healthy wounds, so that they may heal up soundly from the bottom. At the same time we must attend closely to the patient's general health, seeking to maintain the secretions in a natural condition. Various agents have been employed to stimulate the indolent fistulæ; one of the best is the concentrated tincture of cantharides, applied on a camel's-hair brush, or with a fine syringe. Solutions of the sulphate of zinc or copper, and of the nitrate of silver, injected by the syringe, sometimes give good results. An excellent mode is to introduce carefully, as far as possible, a small and flexible silver probe, coated with nitrate of silver; a plain probe having been introduced beforehand as a guide to the length and direction of the passage. It often happens that the external orifice of the sinus is smaller than any other part: in such a case, a little caustic potash should be applied for the purpose of enlarging it, and so permitting free removal of the discharge.

The application of compression to the fistulæ has been tried several times, and success has been claimed for it in two or three cases; in one of which, all ordinary means having failed, a cure was obtained by making the patient apply firmly to the perineum an India-rubber ball, inflated with air, on every occasion before making water, and for some minutes afterwards. This plan was studiously followed during fifteen days, when the opening had soundly cicatrized. Four months after, the patient was perfectly well.

The cure of obstinate urinary fistula has also been attempted by introducing a catheter, and permitting it to remain in the urethra for days together, on the principle of ensuring, as it has been supposed, the passage of the urine through the instrument, and thus preserving from irritation the fistulous passages. Little, however, is thus gained; for experience shows that, however large the instrument may be, and however closely it may fit the urethra at the present moment, before thirty-six hours have elapsed it will lie loosely in the canal, and the urine will pass by its side. It is not possible, indeed, to remove urine from the bladder for any lengthened period by this means without inducing suppuration in the urethra, which is a bar to success.

It is better to withdraw all the patient's urine, by introducing a catheter three or four times a day, or more frequently if necessary. When the patient can do this cleverly for himself, and thus ensure, at every want to pass urine during a period of several weeks, that it is carefully removed without contact with the urethra, a most successful result may be hoped for. I have had an instance of this under my own care, where a large portion of the floor of the urethra being lost, the opening closed after three or four months' attention to this practice.

Free incisions through the fistulæ, down to their origin in the urethra, or nearly so, have been found successful in inducing a healthy process of granulation from the bottom of the wound, and thus in ultimately closing the unnatural passages; provided always, however, that there is no obstruction to the free egress of the urine by the urethra, otherwise no such measures can be of any service. In some cases in which external division of the stricture on a grooved staff is indicated, this operation may be performed in such a manner as to include the fistulous opening in the incision, in which case a successful result may generally be reckoned on. Old chronic perineal fistulæ are sometimes better dealt with by the galvanic cautery than by any other method. Another obstinate species of fistulous passage, communicating with the prostatic urethra, sometimes follows the operation of lithotomy; this also may be often successfully treated by the introduction of an iron wire heated to intensity; the best means of effecting which is undoubtedly the galvanic current, since it maintains as well as produces the required temperature.

A fistulous passage is sometimes prevented from closing by the presence of a small calculus in some part of its course. It may be a small concretion which has escaped from the bladder, or a deposit from unhealthy urine while passing through the sinus. Sometimes it occurs in fistulæ connected with diseased prostate, or with a prostate which is the subject of calculous formations. Fistula associated with the prostate may, however, exist in the absence of any of these causes; such as those which are sometimes connected with prostatic abscess, and which are generally exceedingly obstinate and irremediable.

Fistula is not necessarily a continuous passage from the urethra to the surface; opening from the urethra at one end, it may have a blind or cæcal extremity: hence "blind urinary fistula" has been described. A small tumor, originally formed by a collection of matter, and having a communication with the urethra, constitutes the general form. Its origin has been variously accounted for; some believing it a result of stricture, others of inflammation of the mucous follicles of the urethra. Until the tumor is opened externally, it will not disappear, when it becomes a fistula of the ordinary kind, requiring treatment already indicated.

Urethro-rectal fistulæ sometimes occur as a consequence of stricture or abscess, and more rarely, perhaps, vesico-rectal. In either case their existence is usually first announced by the passage of liquid in an unusual manner and quantity by the anus; sometimes by the appearance of feculent matter in the urine or by the urethra.

I have recently treated a case of urethro-rectal fistula in a gentleman of about twenty years of age, in whom it resulted from acute prostatic abscess following gonorrhœa. The urine passed freely by the anus for some weeks; after trying various means, the use of the catheter, etc., without success, I discovered that by placing him flat on his face during the action of micturition, almost all the urine passed by the urethra. This plan was uniformly adopted for three months. Urine ceased to pass altogether by rectum in a month, and in two more he could pass it in the upright position without any escape. The fistula has remained soundly healed ever since.

If such a plan does not succeed, the actual cautery, and particularly that heated by the galvanic current, affords the best chance of success. It may be applied through the rectum; a speculum having been first introduced, and a full-sized sound carried into the bladder. On the day before the operation the bowels are to be freely purged, and cleared by an enema an hour or two before the application of the cautery, after which they must be prevented from acting for two or three days. The cautery is to be reapplied two or three times if necessary. If the opening is large, the edges should be pared and brought together by silver sutures, after the method of Dr. Marion Sims.

3. The third class of urinary fistulæ comprehends those unnatural openings into the urethra which depend upon actual destruction of substance from the walls of the urethra and superjacent parts. The common causes of these are, sloughing from extravasation of urine, simple and phagedænic ulceration, and mechanical injuries of various kinds. They are for the most part larger, although not invariably so, than any of those already referred to. Generally a portion of the floor of the urethra is destroyed, as well as the structures which have intervened between it and the external surface; so that in many cases more or less of the mucous membrane of the upper aspect of the canal is visible from the outer orifice. As a consequence the whole, or nearly the whole, of the urine passes by the artificial channel in a full stream. Such apertures may be found before the scrotum, and are called ante-scrotal or urethro-penile fistulæ; or in or behind the scrotum, known simply as scrotal and perineal fistulæ.

A broad distinction exists between these two classes in relation to their amenability to treatment, and to the nature of the operations necessary to their cure. Ante-scrotal urethral openings are the most difficult to close, since the coverings of the urethra here possess but little substance. And further, owing to the extreme mobility of the member, and its liability to erection, it is difficult to maintain that perfect steadiness of position so desirable in a part which is the subject of an auto-plastic operation. Nevertheless, with all these difficulties, in addition to that formidable one, the contact of urine, such openings, even when large, are not to be regarded as beyond the reach of surgical skill. The exercise of considerable patience, and of unremitting attention during a long period, is indispensable both to the surgeon and to the patient in a case of urethro-penile fistula requiring a plastic procedure for its cure.

Openings in the perineum involving loss of substance, although by no means easy to close, are remediable with less difficulty, on account of the absence of the conditions just adverted to as the obstacles in ante-scrotal fistulæ.

Treatment.—Ante-scrotal fistulous open-

ings which are of small size, but obviously depending upon loss of substance in some degree, have been closed by repeated applications of a caustic agent to their edges and to the surrounding parts. Of these the nitric acid, the nitrate of silver, or the strong tincture of cantharides have been successfully employed in very small openings.

Dieffenbach used the cantharides, and sometimes combined with it what he called "the lace suture." This he describes as applicable to small fistulæ in the anterior part of the canal. The margin of the fistula and the surrounding skin must be frequently touched during the day previous to the operation with the strong tincture of cantharides. Before using the suture, the loose epidermis is to be removed by scraping, and a sound introduced into the urethra beyond the opening. The operator is then to take "a small curved needle, sharp at the point, but not at its edges, with a stout silk waxed thread, and by means of a needle-holder to introduce it beneath the skin at about three lines from the border of the fistula." The point of the needle is to be carried deeply, but not into the urethra, and made to emerge at another point, about three lines from the margin of the fistulous opening. By three or four of these stitches, the thread is to be carried round the opening, until it finally emerges at the point at which the needle was originally entered. The thread is imbedded in the cellular tissue around the fistula, at about three or four lines' distance from it. Its ends are now to be drawn together slowly, so as gradually to approximate the borders of the fistulous orifice until it is obliterated, and then to be fastened by a knot. In three or four days the ligature may be divided and drawn away. Most commonly, however, some plastic operation is necessary for these openings. The proceedings of Cooper and Earle, the first on record, are the basis of many various proceedings since employed. Space does not admit of the necessary description here. Two of the modes employed for ante-scrotal opening are described in the Essay on PLASTIC SURGERY; I have given others in the second edition of my own work on Stricture and Perineal Fistulæ in some detail.

Retention of urine.—By this term is generally understood a condition in which the patient is unable to pass any urine whatever, or only an extremely small quantity; and is in danger of serious consequences if not relieved at no distant period. Urine may be, and often is, habitually retained in the bladder, while the patient nevertheless passes as much in the twenty-four hours as the kidneys furnish, the reservoir remaining more or less filled. This is engorgement of the bladder, and is not retention, which term is held to indicate an acute and not a chronic condition.

Retention of urine may be caused by simple prostatitis, usually occurring in young and middle-aged subjects; by stricture of the urethra, usually in middle life; and by hypertrophied prostate, in elderly persons only.

The consideration of the first and second forms will come next in order here.

Complete retention.—When any degree of organic stricture exists, however slight, retention of urine is always possible if exposure to the influences of certain exciting causes takes place. Occlusion of the passage may be caused by inflammatory engorgement, or unwonted muscular contraction; more frequently, perhaps, by a combination of both. Sometimes it may be caused by a foreign body, as a small calculus, a portion of a membrane, or the like, obstructing the stricture; and this is probably the rarest form.

In treating retention, the catheter is the first means required in nine cases out of ten, and often the only means. The first point to be ascertained is, is it a case of merely temporary obstruction from inflammation following gonorrhœa, or does it depend on organic stricture of some standing? The next points are the duration of the attack and the condition of the bladder, bearing in mind that while some patients exhibit distension of that viscus almost to the umbilicus, the subject of an old stricture may be in a state of greater danger, although no distension is perceptible above the pubes, owing to the contracted condition of the bladder, which has become natural to him. The treatment varies somewhat in the two cases just briefly described. In the first case, or that of temporary inflammatory obstruction, it has been recommended to employ baths, opium, and depletion before using the catheter; and relief may certainly be afforded in this manner, although at the expense of prolonged suffering to the patient. The object of this plan is to avoid injury to the urethra in its inflamed condition; and if the surgeon is not gentle, or is not skilled in the use of the catheter, it is probably the safest course to follow. But if he employs a light and careful hand, a catheter of rather small size, say No. 4 or 5 of gum-elastic or silver, the former producing less pain, should be at once passed into the bladder; and in these cases this is generally easily accomplished, if the flexible instrument retains a good curve after the stylet is withdrawn. If the surgeon does not succeed in passing an instrument, the

patient should be put into a hot bath, 100° to 103° or 104°, to relax spasm and relieve internal congestion; a full dose of opium should be given by the mouth; and if there is much straining, an enema or suppository containing opium may be also administered with advantage.

If there is much inflammation about the parts, as shown by a swollen penis, urethral discharge, and tender perineum, cupping or a dozen leeches on the latter region are decidedly useful, in the event of retention persisting; generally, however, some relief follows the use of the bath and the opium, which latter may be repeated two or three times, to insure its full action on the system. There are very few cases among those here regarded as inflammatory or spasmodic that will not yield; sometimes slowly without further catheterization, sometimes by means of an instrument, which may often be passed with comparative ease after the treatment described.

There are some instances where the difficulty seems more spasmodic than inflammatory, in which repeated doses of the tinct. ferri sesquichl., that is to say 15 or 20 minims every quarter of an hour, administered four or six times, relieve the retention. When, on the other hand, we have to deal with retention resulting from confirmed organic stricture, it is better at once to examine the urethra in the usual way, that is, with a full-sized instrument; and, having ascertained the locality of the obstruction, patiently to devote a long time to the careful use of the smallest catheters, silver and gum. In relation to its management, see p. 794, on Catheterism in difficult cases. If this proves unsuccessful, the hot bath must be resorted to; and after faintness has been induced, the catheter may be again employed while the patient is still in the bath.

[The aspirator is the modern means always ready at a surgeon's hand for use in such emergencies as retention, where the ordinary means do not promptly succeed. The bladder may be emptied two or three times a day by aspiration through a fine exploring tube without the least danger, provided the bladder is distended so as to mount above the pubes, and the precautions applicable to all aspiratory efforts be observed. This allows time for proper cautious efforts to be made to re-establish the proper channel, or, failing in this, to decide upon the best means to open a new and permanent route.]

Further treatment, if necessary, must depend upon the condition of the patient. Generally, opium should be given by enema and by mouth, after which the catheter is again to be used. The time which is to be devoted to the employment of all these means must be regulated by the judgment of the surgeon. The condition of the patient, and a knowledge of the time during which absolute retention has existed, will enable him to decide the question of affording relief by some other measures. Chloroform [or ether] is an agent of great value in obstinate retention. It relaxes the muscles; by causing insensibility it overcomes involuntary resistance and straining, and thus enables the surgeon to use the catheter with greater advantage, although not with more force, than without its influence.

But supposing none of the treatment hitherto employed has been successful, that the patient's condition is urgent, the next proceeding is to afford relief by making an artificial opening either into the bladder or the urethra.

To effect this, the following operations are employed:—

The stricture may be "forced;" or, the urethra may be opened at or behind the stricture; and the bladder may be punctured, either by the rectum, above the pubes, or through the pubic symphysis.

1. The first method, or "forcing" a stricture, is rarely performed now with deliberate intention. It consists in driving a catheter of moderate size forcibly through the obstacles which oppose its course, in the direction of the bladder, which when reached is evacuated, and the instrument is tied in. I have seen it successful in old, hard strictures. But it is not a proceeding which can be recommended in competition with those less harsh and dangerous proceedings which are generally practised by modern surgeons.

2. The urethra may be opened, first, by a dissection from the surface to the stricture, and through it, according to the method already described as perineal section (p. 803); secondly, the urethra may be opened behind the stricture, the bladder relieved, and the obstruction divided subsequently. Both these are difficult operations. Especially when the perineum is thickened and indurated, it is by no means always certainly possible to dissect through the stricture from the front, or to hit the urethra behind the obstruction. The perineal section, under such circumstances, often fails to trace the narrowed channel, and sometimes even to discover the urethra at all; and a prolonged operation, with much loss of blood, not unfrequently results in failure to relieve the patient.

The method of opening the urethra by an incision made altogether behind the stricture was recommended in this country by Guthrie and Liston, but is very rarely performed, the puncture of the

bladder per rectum being now generally preferred. The operation is performed by introducing the left forefinger into the rectum, to distinguish the apex of the prostate, and entering a straight sharp-pointed bistoury with the right hand just in front of the anus, so as to hit upon the urethra at the point indicated by the finger in the rectum. The knife is carried upwards exactly in the median line, so as to make an incision of one or two inches in length. In this manner the urethra is to be sought, and the stricture afterwards divided forwards or not, as the operator determines to be most desirable.

3. The bladder may be punctured in two principal ways, viz., by the rectum, and above the pubes; to which may be added a third, through the pubic symphysis. Formerly it was also punctured by a direct stab from the perineum—a dangerous proceeding, now wholly obsolete.

Puncture by the rectum is the operation most commonly adopted at the present day. Its results have been carefully studied of late years, and have been brought before the profession more prominently by Mr. Cock, who has done much to test its value. The result of his conclusions is, that it is fraught with less danger, and is more easy of performance, than any other which is adopted for the relief of retention. The objections made to it are: the liability to abscess between the rectum and the bladder; a persistent fistulous opening there; injury to the seminal vesicles, leading to suppuration of the testicle; and the danger of perforating the peritoneum with the trocar, and thus inducing inflammation of that membrane and a fatal result. The last-named, and the most serious, of these accidents is happily that which may most easily be avoided. After an examination of several cases by dissection, it is my opinion that the peritoneum is out of reach of the trocar when employed with a moderate degree of care. The puncture usually falls short of the peritoneal pouch by an inch at least. The other results do occasionally, but only rarely, occur.

The operation is thus performed:—The rectum being emptied by an enema, the patient is placed in the position for lithotomy, and firmly held by two assistants. The operator then introduces the left forefinger, oiled, into the rectum, and defines the posterior margin of the prostate, beyond which the finger should be extended if possible. Fluctuation should be obtained there, from the contents of the bladder, by a tap made on the hypogastric region, unless the viscus be very contracted indeed, in which case the propriety of operating is doubtful, since the trocar may enter the opposite coat of the bladder, from absence of the requisite amount of distension. Having determined the spot at which fluctuation is most distinct, and directed an assistant to place a hand on each side of the suprapubic region to support the bladder, a well-curved trocar, seven or eight inches long, is carried along the finger in the middle line to the part indicated, the handle well depressed, and the point carried through the coats of the rectum and bladder, until it is felt free in the cavity of the latter. The stilet is withdrawn, and the canula, or a flexible tube passed through it, retained by a bandage and tapes. The length of time it should remain will depend on the amenability of the stricture to treatment. If this yields, the urine will pass through the natural channel, and the opening in the rectum will readily close. Little fear need be entertained of the continuance of a fistulous opening; for on several occasions on which the canula has escaped by accident, it has been impossible to replace it, and a fresh puncture has been necessary. When it is impossible to find fluctuation by the rectum, or when the prostate is enormously enlarged, this operation, as a rule, is not to be employed.

Puncture of the bladder above the pubes is performed as follows: The patient being placed in a half-reclining position, and the pubes shaved, a vertical incision of the integument is made directly above the symphysis pubis, about an inch and a half or two inches in length at the surface; this is to be carried downwards through the linea alba, so as just to admit the tip of the finger to reach the distended bladder. Meantime an assistant, standing behind the patient, places one of his hands on either side against the abdominal walls, so as to steady the bladder. A straight or slightly-curved trocar (if the latter, the convexity of the curve should be upwards) is then to be carried with a very little inclination downwards into the bladder. After the operation the canula should be exchanged for a silver tube, specially adapted to slide through it, secured by tapes and a T-bandage, which may remain a day or two until lymph has been effused upon the edges of the wound, when it may be withdrawn, and a gum-elastic catheter worn in its place, an instrument which is generally better tolerated by the bladder than one made of metal. For most cases of retention in which this operation is required, this mode of performing it will probably be still the most desirable to adopt.

But a very ingenious proposal, originating in Paris last year with Dr. Dieulafoy, and since twice realized on the living patient, must not be left without notice. Dr. Dieulafoy has applied his "aspiration" apparatus to the distended bladder successfully in the following manner: He

inserts a very fine trocar, no larger than a small exploring needle, close above the pubes into the tumor; if it reaches the bladder a drop or so of urine may issue; he now applies the vacuum instrument to it, and a strong jet of urine instantly appears and soon fills the instrument; this is discharged by a side tap, a new vacuum is created by a stroke of the piston, and the process is repeated. In this manner three or four pints of urine may be withdrawn by this minute channel in fifteen or twenty minutes, and the trocar withdrawn with a scarcely perceptible puncture. I have never yet applied this apparatus to the bladder, although I have proved its exceedingly perfect action twice in paracentesis thoracis. If one evacuation of the bladder were sufficient, this very simple operation would suffice, but if a route for succeeding acts of micturition is required, as is almost always the case, a larger opening is necessary. Still the large trocar generally employed is by no means necessary: thus my own trocar for puncture above the pubes is only equal to a No. 6 catheter in size, and it is sufficiently large for all purposes. By means of a stylet lengthened by screwing to its end an additional length, forming a guide, a gum-elastic tube may be slipped into the bladder in place of the trocar and canula when these are withdrawn.

The puncture through the symphysis pubis was first proposed by Dr. J. M. Brander, of Jersey, in 1825, and several successful cases have since occurred in the practice of himself and others. He has usually employed a hydrocele trocar of medium size for the operation, which is thus performed. The patient should recline, and the trocar is introduced—whether after a small preliminary division of the integuments or without it, appears to be immaterial—about the centre of the symphysis, reckoning from above downwards, and in a direction at about right angles to the vertical axis of the body. Dr. Brander says, "somewhat obliquely downwards and backwards towards the sacrum, varying the direction according to circumstances"; a piece of flexible catheter is then to be introduced through the canula," and retained by a tape. I attempted to perform this operation some time ago, and could not penetrate the symphysis, although the trocar was strong and not large in calibre. With more improved methods of supra-pubic puncture, as above referred to, and by rectum, I should think this mode should not be in future considered, certainly in the cases of elderly persons where the cartilage is very firm or ossified.

In considering these methods of affording relief to the distended bladder in reference to any case which requires an operation, the question to be first solved is the following:—

Are the patient's powers and condition such as to compel us to prefer the simplest method of affording immediate relief, without regard to ulterior results? If so, unless the urethra can be felt in the perineum distended with urine, which may sometimes be the case, especially if that region be not thickened or deformed, the rectal puncture of the bladder, supposing the prostate not to interfere (putting aside the puncture by the symphysis, as not yet sufficiently tested by experience to be considered on equal terms with the older operations), is generally the simplest method, as it affords instantaneous relief at the smallest possible expense to the patient's powers. But if it is probable that the canula may be required for a longer period of time following the operation, I then prefer the supra-pubic method, especially if the bladder is distended, as it is inconvenient and distressing to a patient to maintain a canula in the rectum for more than a few days; whereas I have seen patients wearing with perfect comfort a tube for many years above the symphysis pubis. Again—but this is rare—if distension of the urethra is perceived in the perineum, a lancet or sharp-pointed bistoury may be carried into it, and a female catheter introduced by its side before it is withdrawn; or if the powers of the patient are good, and the condition of the parts is natural, perineal section may be employed. Having relieved the bladder, we can make a careful attempt to divide the stricture, by introducing a fine probe from below upwards through the stricture, and passing a catheter into the bladder. If, however, induration and deformity of the perineum exist, as above indicated, the crisis of retention is not generally a favorable time for adopting this proceeding.

The treatment of retention of urine from hypertrophy of the prostate.—When retention suddenly occurs in these cases, it is due to local congestion or inflammation. Hypertrophy occurs only after middle life, and develops itself slowly; and when much obstruction exists, very slight exposure to cold, or an excess in wine or in sexual excitement, may produce total retention. When this happens, catheterism is usually absolutely necessary; for, although partial relief may be afforded by the measures already described, which avail to reduce congestion, inflammation, spasm, and pain, the bladder can rarely be emptied by any other than artificial measures. If, then, the use of the hot bath and of opium has been attended with little success, we are at once to use the catheter. In these cases a well-curved gum catheter, of good size, say 9 or 10, and with or without a stylet, will often

pass more easily than any other; but it should have been kept on an over-curved stylet for a considerable time, in order to impart to it that permanency of curvature without the stylet, which is essential to success in its employment. It is scarcely possible to overrate the value of instruments thus treated. But in the absence of such a one, and also in some cases where the prostate is unusually large, it is necessary to employ a silver prostatic catheter. This should not be less in size than No. 9 or 10; it should be from 12 to 14 inches long from the rings on the handle to the end of its beak or point; and the curved portion should comprise about a fourth to a third of a circle, which measures from 4½ to 5½ inches in diameter; the mean of these being, perhaps, the most generally useful size.

In passing the ordinary prostatic catheter, any difficulty met with is usually confined to that part of its course where it arrives at the neck of the bladder. In most instances its point requires to be tilted up over the tumid prostate. On this account a beaked catheter, that is, one resembling in form a lithotrite, will sometimes pass readily when the former fails. Occasionally a stout wire stylet in the gum catheter becomes of essential service, by permitting us to alter materially the form of the instrument as required. Further, it enables us to put in practice a manœuvre of considerable utility, well known as having been originated by the late William Hey, of Leeds, which may be thus described: the catheter, mounted on its stylet, having been introduced as far as the obstacle, the stylet is then withdrawn about an inch, which has the effect of increasing the curve and elevating the point of the catheter, so as often to carry it over the enlarged portion in a manner less easily accomplished in any other way.

The question occasionally arises, is it desirable at once to evacuate the entire contents of the bladder when retention has existed for a considerable period of time? In very rare instances the removal of a large quantity of urine, amounting to several pints, especially when an upright position of the patient has been incautiously permitted, has been followed by fainting and depression, from which he has never rallied. When the extent of vesical dulness is very considerable, it is therefore prudent to afford relief in a gradual manner; and, supposing that the catheter is retained, this may easily be accomplished. The removal of some thirty or forty ounces will probably afford complete ease, and after the lapse of half an hour or an hour another portion may be withdrawn; in this manner the bladder may be gradually brought to adapt itself to the normal condition of contraction, which subsequently, as a rule, must be ensured at least once or twice a day. It is not long since my evidence was required in a court of law, in a case in which death had occurred instantly after six pints of urine had been suddenly withdrawn in the upright position.

A point of importance remains. A catheter having been introduced with difficulty for the relief of retention, should it be permitted to remain? The answer must depend on circumstances. In support of the negative, if the parts are already in a state of considerable irritation, it is undesirable to permit any chances of adding to it, of which the presence of a catheter may be one. On the other hand, the bladder, after long retention, will very soon fill again, and less hazard may be incurred by the presence of the instrument than by a repetition of the efforts to place it there, especially if great difficulty was experienced in passing it in the first instance. Greater weight usually attaches to the latter consideration, as a rule, than to the former. I have often seen great danger incurred by the too early removal of a catheter which had relieved an urgent attack of retention.

If, however, which very rarely happens, catheterism proves unsuccessful, and relief is necessary, the bladder may be punctured or the prostate perforated. For the methods of performing the former operation, see page 813. If the prostate be very large, the rectum is not so convenient a situation for the proceeding as the suprapubic region, which is therefore generally adopted. I have punctured by rectum with the best results for retention from enlarged prostate, but then a fluctuating point was within reach of the finger, in which case it would be safe; this condition, however, is to be regarded as exceptional.

Perforation of the obstructing portion of the prostate may be performed with a strong silver catheter, about No. 9 or 10 in size, and rather longer than the ordinary catheter, but not possessing the large curve of the full prostatic instrument. The operator introduces this to the seat of obstruction, and satisfies himself by means of a finger in the rectum that it lies fairly in the urethra, and is engaged in the prostate; he then steadily carries it onward towards the cavity of the bladder, by pressing the point firmly forwards, and at the same time slowly depressing the handle; and he desists on feeling that the point is free in a cavity, and on finding that the urine flows through the instrument. This was done by Home and Brodie. Liston employed a cutting stylet "carried through a slightly-curved and long canula," and

"practised the operation a few times successfully." Whatever be the instrument employed, the surgeon is careful to maintain it in the middle line, and also to aim at making the point emerge just behind the neck of the bladder, neither too near the pubes on the one extreme, nor the posterior wall of the bladder on the other. The catheter or canula, as the case may be, should be retained not less than forty-eight hours afterwards in the bladder, that the tissues around may consolidate, and no difficulty be experienced in replacing it by a catheter when withdrawn.

Extravasation of urine from rupture of the urethra may take place during unrelieved retention of urine by the giving way of the urethra at some point; it is very rare indeed that the bladder itself is ruptured. In either case, however, mechanical distension is not the direct nor the only cause. Ulceration of the mucous membrane behind the stricture, increased by the influence of urine in almost constant contact with it, causes a breach of the urethral walls. The bladder contracting drives the urine with great force into the cellular interspaces of the superficial fascia of the scrotum and abdomen, when the rupture occurs anterior to the membranous portion, as is almost invariably the case. The situation of the swelling and inflammation is characteristic in these cases, because the course of the extravasated urine is defined and limited by the union of the superficial with the deep layers of fascia at certain points. Thus the scrotum is first gently distended; a bag, as it were, being formed by the union of the superficial and deep fasciæ across the perineum, and by their connection with the pubic rami. As the fluid increases, it rises into the coverings of the penis and over the pubes and abdomen, but does not descend to the thighs, because in the line of Poupart's ligament these fasciæ are similarly blended, and prevent the passage of urine beyond their junction. The consequences of this extravasation are extremely disastrous; an unhealthy inflammation results from the irritating fluid wherever it goes, and the areolar connections of the skin and subjacent tissues are destroyed. If unrelieved, the distension becomes enormous, the scrotum sometimes attaining the size of a human head; the skin assumes a dusky red hue, or becomes purplish and livid; and gangrenous spots are sometimes apparent; not unfrequently such a one is seen on the dorsum of the penis, and is generally regarded as a very unfavorable sign, although by no means one that is necessarily fatal. The general condition of the system is one of great depression; and unless complete relief be afforded, the patient must inevitably soon succumb. He is frequently delirious, with brown tongue and extremely feeble pulse, when the extravasation is considerable.

In these circumstances it is necessary at once to make free and depending incisions into the distended parts. The scrotum especially demands a deep incision on either side of the middle line, frequently the pubes, and the penis itself also. These incisions will not only free the parts from the extravasated urine, but provide for its passage from the bladder. By these openings the purulent matters, débris, and sloughs will subsequently come away, often in very large quantity. No immediate measures for the cure of the stricture are necessary, as in the present state of the patient they are neither practicable nor advisable; although it is probable that when the retention is relieved a catheter may be passed into the bladder by the urethra; however, there is no occasion to do this until the system has rallied, which it often does to a marvellous extent. In a few hours the sufferer may emerge from a state of utter prostration to one of comparative comfort and promise; the symptoms of depression and exhaustion sometimes disappearing as by a charm, unless the injury inflicted has been too extensive to admit of repair. Meantime, abundance of alcoholic stimulant and nutriment must be given to support the powers of life. Chlorate of potash, ammonia, and bark are often serviceable. Opiates are rarely necessary, unless symptoms of nervous excitement appear.

However favorably the patient progresses, a considerable amount of sloughing takes place. This is commonly the case with the scrotum to a greater or less extent; both testicles are sometimes completely stripped of their coverings, and are seen bare in the wound, and even hanging by the cord. During this process the removal of the products of decomposition and the cleanliness of the parts must be provided for. Antiseptic applications, frequently changed, as yeast or beer-ground poultices, linseed-meal or charcoal poultices, with a few drops of the chlorides of lime or soda well stirred in, promote these indications. The use of the disinfecting chlorides, of carbolic acid, or of powdered charcoal, and free ventilation of the room, should be adopted.

If the extravasation have taken place between the two layers of the deep perineal fascia, a firm, hard, and deep-seated swelling may sometimes, but not always, be detected in the perineum. This is to be at once freely opened. If it occur behind the fascia altogether—but this is very rare—the urine finds its way upwards

around the base of the bladder, and a fatal result is inevitable.

Rupture of the bladder.—This accident is excessively rare except as the result of direct violence. It then usually occurs from a blow on the abdomen or from a fall, when the viscus is distended with urine. It may be occasioned by a fragment of bone when the pelvis is fractured (see INJURIES OF THE PELVIS, Vol. I.). When it happens as a sequence to stricture, it does so by a process of the same nature as that already described as affecting the urethra, although it may not always occur in the bladder, properly speaking, but in a thin and dilated sacculus springing from it. Occasionally the discharge of its contents takes place directly into the peritoneal cavity, more commonly into the cellular connections of the organ below the line of its peritoneal coat, after which it may secondarily escape through the peritoneum or not. In any case a recovery has never been known to happen, and can scarcely be regarded as possible.

[The paper of Mr. Birkett in this surgery treats of this question. Smith's paper upon the subject is classical.[1] He mentions five recoveries in seventy-eight cases, and in one of the five the extravasation is stated to have been intra-peritoneal. Bartels's report contains valuable information on this subject.[2] His report includes one successful case of abdominal section for rupture of the bladder, and he believes that extra-peritoneal infiltration due to rupture is fatal in 74 per cent.

Alfred Willett performed abdominal section for rupture of the bladder, but without saving his patient.[3] That apparently desperate cases of extra-peritoneal extravasation from rupture may recover is proved by Syme's case.[4] Walker, of Boston, and Mason, of New York, have reported successful cases of operation for ruptured bladder by the lateral section of the neck of the bladder through the perineum. Bartels's paper contains the history of thirteen cases of injury of the bladder through the rectum. Of these, three died from peritoneal injury; the rest got well, showing the advantage of dependent drainage. Christopher Heath's paper on the subject is one of the most interesting extant.[1] He performed laparotomy in one case, without success. Heath refers to Chaldecott's case as being one of undoubted rupture into the peritoneal cavity, where recovery followed without operation. Walter reports a successful case of laparotomy in the Phila. Med. and Surg. Reporter, Feb., 1862. Bonet and Cusack are referred to by Heath as having unsuccessfully opened the abdomen, and Thorp's case is recorded and his method endorsed. In Thorp's case there was rupture into the peritoneal cavity. Thorp washed the peritoneal cavity clean, through a catheter passed by the urethra, and then tied the catheter in the bladder. The patient recovered.]

The symptoms of vesical rupture take place after a prolonged but not necessarily absolute retention, for some surplus of urine may have been previously escaping by the urethra. The patient usually states that he has felt something give way. Acute abdominal pain then sets in; the belly becomes exceedingly tender and distended; the features are pinched and anxious; the breathing hurried; obstinate hiccough occurs, sometimes vomiting; the pulse is sharp, quick, and irregular; the flow of urine ceases altogether, as also does the straining to void it. General fluctuation may be sometimes found in the abdomen, and inordinate distension of the bladder, before felt in the rectum beyond the prostate, has now disappeared. Sometimes the patient is delirious, and even maniacal. And after a period varying from thirty-six hours to four or five days from the time of the accident, during which the patient's agonies are extreme, death takes place.

The indications of treatment which, in the absence of experience, we should endeavor to fulfil, would be as follows: To provide for the free exit of the urine from the bladder by puncture; to alleviate suffering by large doses of opium, with hot fomentations and rubefacients to the abdomen; and to support the powers of life. Whether an attempt to remove the urine in case of extravasation into the abdominal cavity, by puncture of its walls, should ever be entertained, is an unsolved question. Such a proceeding affords the only chance (exceedingly slender as it is) of recovery which surgical aid could afford.

[1 New York Journal of Medicine, 1857.]
[2 Langenbeck's Archiv, xxii., 3 and 4.]
[3 St. Barth. Hospital Reports, 1876, p. 209.]
[4 Contribution to Surgery, Edinburgh, 1848, p. 332.]

[1 Med. Chir. Trans., vol. lxii., p. 336.]

URINARY CALCULI AND LITHOTOMY.

By Alfred Poland, Esq.

Revised by Edward L. Keyes, A.M., M.D.

Of all the ailments to which the human frame is liable, that of the formation of a stone or calculus in the kidney, bladder, or urinary passages is undoubtedly one of the most formidable and important. And on account of the tendency of this formation to become lodged in certain dilated portions of the urinary apparatus behind natural necessary narrowings, it is thereby rendered liable to increase in size, and consequently soon to become impassable and incapable of expulsion. The stone now acts as a foreign body, and irritates the delicate structure of the part in which it is retained, causing at first local disturbance and mischief, afterwards seriously involving the constitution, and ultimately leading to a miserable existence, which most frequently terminates in a lingering death.

In order to comprehend more fully the subject in all its bearings, it behooves us to take into consideration the causes and formation of stone; and in doing so we must necessarily review cursorily the circumstances which may give rise to this affection, by passing in survey the more simple and slight deviations of the urinary fluid, then its more aggravated changes from the condition of health, until we arrive at those still more complex and dangerous forms which cause the amalgamation of the deposits into a mass, constituting a stone.

But previous to these inquiries, it is the essential duty of the surgeon to be well acquainted with the urine in a state of health, and in its varied conditions under every circumstance. He should know its chemical constitution, its specific gravity, its amount of acidity, its variety of color, its microscopical appearances, etc.; and not only this, but he must also bear in mind the changes which the urine undergoes during certain conditions of the body, and during certain periods of the day; thus there is the urine of the blood, passed early in the morning before any repast; the urine after the use of drinks; and the urine after the partaking of solids—all modifying the condition of the constituents. All these points are carefully detailed in our standard chemical and physiological works, and in the numerous special monographs on the urine, to which the reader is referred.

In making a careful analysis of the constituents of the urine, we find that there are two sources from which an abnormal condition may arise; and that an excess or deficiency of the elements from either of these sources may disturb the balance, and thus dispose to a precipitation of one or other of the constituents, causing deposits. The one source is from the organic elements, and of these urea and uric acid are the most frequent. Urea bears the proportion of 12 or 15 to 30 or 40 parts in 1000 parts of urine; it is exceedingly soluble and liable to decomposition, with a development of ammonia, which is accelerated by mucus or other animal substances becoming putrid; this may take place in the urine in the bladder under certain diseased actions, and prove an abundant source for calculus. Uric acid, on the contrary, exists in very small proportions,—half a gr. to one gr. in 1000 grs. of urine; it is very insoluble in water, so that any excess of living, such as increased animal diet, will cause a ready deposition of this substance; hence the frequency of deposits and calculi of uric acid; and from this being the chief constituent of most stones, the deposit has derived the name of lithic acid. The other source is from the inorganic constituents, the salts of the urine; these comprise saline and mineral ingredients. The saline are soluble in water, and consist of sulphuric, phosphoric, and hydrochloric acids, in combination with their bases, potash and soda. The mineral salts are insoluble in water, and consist of phosphoric and occasionally carbonic acids, in combination with their bases, lime, magnesia, and sometimes alumina; traces of silica are occasionally met with. Of these salts the phosphates are the most important, as being more readily prone to be deposited.

Urinary deposits.[1]—These may be ad-

[1] In giving a description of urinary deposits and urinary calculi, the author has availed himself of the standard works; for more mi

vantageously arranged under the foregoing two chief heads: 1, the uric acid and urate deposits, with their allies the oxalate, uric oxide, and cystic oxide varieties, derived from the organic or animal elements of the urine; and, 2, the phosphates and the carbonate of lime, deposited from the inorganic elements or salts of the urine. But besides these two varieties there are other deposits to which we shall merely direct attention, without entering into a description of them, viz., the non-crystalline organic products, such as blood, pus, mucus, epithelium, spermatozoa, milk, fatty matter, etc.; and the high-colored deposits of doubtful origin, viz., cyanourine, melanourine, indigo, Prussian-blue. Two rare forms of deposit, the fibrinous and uro-stealith, will be alluded to under the head of calculi.

1. The *uric acid deposits* may be simply a yellow-pink, red, or lateritious sediment, composed of variously-formed crystals: these crystals, however, may collect

Fig. 458.

Uric acid.

into uniform masses, producing a kind of sand, of about one-fortieth to one-sixtieth of an inch in diameter, and mostly globular or oblong; again, such masses may concrete and form a diminutive kind of calculus, called gravel, attaining often the size of a pea, and capable of being passed with the urine. The crystals very commonly consist of rhombic plates, with the obtuse angles more or less rounded off, or acuminated doubly-convex lozenge-shaped plates; but the normal form is the rhombic prism. By the addition of acetic, nitric, or hydrochloric acid, uric acid may be separated from its salts in the form of rhombic tablets or six-sided prisms. Dr. A. E. Sansom[1] states that the form of the crystal is much affected by the strength of the acid which is added; thus, where the acid is small in quantity, the crystals are regular, mostly tables, squares, and lozenges; where the acid is in larger quantity, added to a strong solution of urate of ammonia, they consist of large and long tables, with very elongated lozenges; and where the acid is strong, and amorphous urate itself used, the crystals most frequent are acicular prisms. The causes which give rise to this deposit are described by Dr. G. Bird[1] to be: 1, the waste of tissues being more rapid than the supply, as in fever, rheumatism, etc.; 2, the supply of nitrogen in the food being greater than is required for the reparation of the tissues, as in over-indulgence, especially in the use of animal food; 3, the process of digestion being insufficient to assimilate an ordinary and normal supply of food, as in dyspepsia; 4, obstruction to the cutaneous outlet for nitrogenized secretions, as met with in diseases of the skin, variability of the climate, etc.; 5, congestion of the kidneys, following injury or disease of the organ. Imperfect respiration is also said to be a cause of an undue proportion of uric acid in the urine, owing to an excess of carbon and oxygen uniting with urea. The treatment to be adopted will of course be to control and remedy the cause by abstinence from over-indulgence in animal food, regular diet, exercise, free action on the skin by baths and moderate diaphoretics, mild diuretics, diluents, liberal use of good water, and so on.

2. The *urates*, generally known as the urates of ammonia, form the most frequent urinary deposits. Heintz[2] regarded these deposits as consisting of urate of soda and urate of ammonia, with traces of urates of lime and magnesia. Their color is a pale fawn, but it may vary from snow-white, through every tint, to brick-red, pink, or purple. Dr. Bird remarks, that in the white, fawn, or brick-red deposit there is a deficient state of the cutaneous functions; whilst in the pink, crimson, or purple variety there is more or less evidence of functional or organic derangement of the liver, spleen, or other organs influenced by the portal circulation, which is attributed by some to the presence of purpurine, and by others to the obstructed elimination of carbon, as in rheumatism, gout, and diseases of the liver or spleen. The alkaline urates generally form an amorphous deposit of minute spheres, having protruding therefrom acicular spiculæ of sharp crystals of uric acid. Some describe two forms of fawn-colored deposit of urate of ammonia: the one, in which the precipitate

nute detail reference must be made to the works of Bird, Beale, Thudichum, Bence Jones, the Catalogue of Calculi of R.C.S. England, Hassall, etc.

[1] Beale, On the Urine, p. 293.

[1] On Urinary Deposits, 5th edit., p. 159.

[2] Lehrbuch der Zoochemie.

mixes readily with the supernatant fluid by slight agitation, appears to form a very homogeneous mixture, and subsides exceedingly slowly by repose; the other, with frequent admixture of crystals of

Fig. 459.

Urate of ammonia.

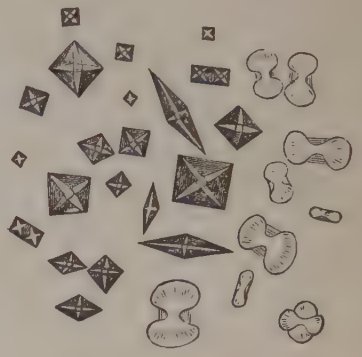
pure uric acid forming a pale urine, with diffusion of the deposit through the fluid in detached bran-like particles, which readily subside, and occasionally form dense clouds in the fluid, like puriform mucus, disappearing on heating; the urine is of low specific gravity. Sometimes the deposit becomes quite white, and often assumes a mucilaginous or jelly-like character.

The causes and treatment are, for the most part, those of the uric acid deposit. Open air, healthy residence, and tonics, either mineral or vegetable, are essential.

3. The *uric oxide* deposits, otherwise called xanthic oxide or xanthine, closely resemble uric acid, but the conditions of the urine depositing them are unknown. It is supposed that these depend upon an imperfect oxidation of the materials from which uric acid is eliminated by the ordinary processes of the kidney.

4. The *oxalates* are usually observed in the form of oxalate of lime, the crystals consisting of two varieties. One of these is the quadratic octahedron class, which generally have one axis much shorter than the other two. Their varieties in shape are due to the position in which they are viewed, some even being flattened and square, and resembling the back of a letter envelope. The other variety is the dumb-bell-shaped crystal; this is considered by many to be formed by oxalurate of lime, and by others to consist of uric acid, both of which fallacies are explained in Dr. Beale's work, p. 300 *et seq.* The dumb-bell crystals often unite into a mass, and form the nucleus of a concretion called the hemp-seed calculus. Dr. G. Bird considered these deposits to be due to an increased oxidation of the uric acid formation, and believed that they never exist in healthy urine, although their constituents are present under one form or another. Lime is al-

Fig. 460.



Oxalate of lime.

ways present in the urine, combined with phosphoric and perhaps other acids; and so great is the insolubility of the oxalate of lime, and so intense the mutual affinity of its constituents, that the addition of oxalic acid as a soluble oxalate instantly determines the precipitation of the salt. The particular manner in which the evolution of the oxalic acid found in the urine occurs can scarcely be regarded as at all satisfactorily explained; most, however, seem to regard it as a secondary product of the oxidation of the saccharine matter occasionally present in the secretions, and thus appear inclined to draw a close analogy between the diathesis in which sugar and that in which oxalic acid is generated. Dr. Prout maintained that oxalic acid is one of the results of imperfect digestion, and that it is derived from vegetable food, more especially such as contains sugar. Liebig taught that it arises from the imperfect oxidation of uric acid during the metamorphosis of the living tissues; if the supply of oxygen fails to a certain extent, the products of combustion in the lungs are urea, oxalic acid, and the substance called allantoin. Dr. Owen Rees[1] considers that the oxalate of lime concretion is formed by the decomposition of uric acid, or of an urate, in the kidneys or bladder; these are converted into oxalic acid, which unites with the lime, so that the oxalitic diathesis is an accidental and unimportant modification of the uric acid diathesis.

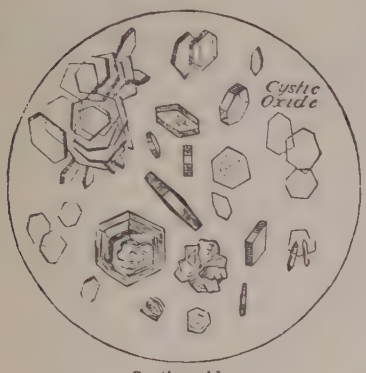
The causes of this condition have been attributed to great nervous depression, as from grief, loss of blood, malaria; and of

[1] Croonian Lectures, London, 1856.

course the treatment will be to counteract these causes, and to pay great attention to diet and the action of the skin; as also to avoid all articles containing or liable to produce sugar, as fruits, fermenting liquors, and substances into which oxalic acid enters as a constituent; mineral acids are highly beneficial.

5. The *cystic oxide* deposits, or cystine, are considered to be modifications in which the urea and uric acid are replaced by an excessive elimination of sulphur. The

Fig. 461.



Cystic oxide.

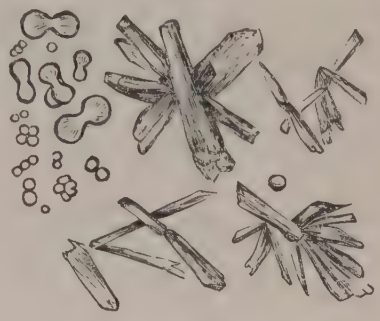
deposit is described to be bulky and easily diffusible, resembling in appearance the white or pale lithates, and to consist of more or less distinct six-sided plates, variously super-imposed one upon the other, the centre portion of the crystals being somewhat opaque. Dr. G. Bird believed that it does not exist in healthy urine, and rarely in morbid; but is probably derived from the sulphur extractive matter of the urine; and he inferred that it proceeds from the waste of tissues and of the hemato-globuline. In the majority of the sufferers the general health and nutrition have been bad. The indications for treatment are acids and tonics, such as nitro-hydrochloric acid, chalybeates, etc.

We now come to the deposits, for the most part of inorganic origin:—

6. The *phosphatic* deposits. The phosphatic salts in healthy urine are of two kinds, the alkaline and the earthy phosphates. The alkaline includes the phosphate of soda, the acid phosphate of soda, and the phosphates of soda and ammonia, which are perfectly soluble, and do not give rise to deposits or concretions. The earthy phosphates, viz., phosphate of lime and magnesia, occur in very small quantities, and are eliminated in a perfect state of solution, but under certain circumstances and certain morbid actions are readily deposited and form concretions. These earthy phosphates are insoluble in water, but are dissolved by mineral acids; they are soluble in organic acids; albuminous substances dissolve them, but the salts are again readily precipitated by ammonia. Thus the phosphatic deposits are derived from the earthy phosphates of the urine, and comprise three varieties:—

1st. The *phosphate of lime*. The deposits of this salt, Dr. Bird observes, have led to more errors than any other class.

Fig. 462.



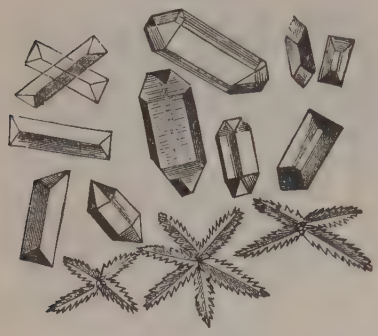
Phosphate of lime.

Where it exists in the urine in solution, or is precipitable by heat, it has repeatedly been mistaken for albumen; and where it has formed the great mass of a deposit, has as frequently been mistaken for pus or purulent mucus. The deposits consist generally of a white amorphous matter, not in crystals, but as minute granules; after standing for some days, little spherules are very frequently found. Dr. Beale says that this phosphate may also assume the form of minute dumb-bells; an appearance probably due to the adhesion of two little spherules, which afterwards become coated with a fresh deposit of the phosphate. Dr. Hassall, in the Trans. Roy. Soc., January, 1860, where he gives a detailed account of it, states that it is more frequently found in a crystalline form in the urine than in an amorphous character. He describes the crystals as either single or aggregated, forming glomeruli or rosettes; and the more perfect crystals as having an oblique, six-sided, prismatic form.[1] 2. The deposits of *ammonio-phosphate of magnesia* (the triple phosphate of magnesia and ammonia) generally assume the form of crystals or triangular prisms with truncated extremities, the terminal edges of which are sometimes bevelled off; or of four-sided prisms and irregular six-sided plates; or again, of stellate crystals, when ammonia has been added to the urine. The urine in this variety is often of a natural color, of rather high specific gravity,

[1] Hassall, Urine in Health and Disease, 2d edit., p. 212.

and is sometimes neutral, often acid, and seldom alkaline; it evolves a pungent, disagreeable, and even fetid odor, which has been usually, but erroneously, denominated ammoniacal. 3d. The deposits consisting of a combination of the two foregoing, viz., *the phosphate of lime* and *triple phosphate*, which is also called the *mixed* or *fusible* variety of phosphates.

Fig. 463.



Triple phosphate.

The causes of phosphatic deposits are generally considered to be an alkaline state of the urine, from a diminution of the requisite acidity; this alkaline condition being due to local disease, injury of the urinary organs, the presence of foreign bodies, or to general morbid conditions, such as over-exertion, vital depression, spinal disease, insufficient food, or abuse of alkalies and medicines. The source of this alkali may be an excess of carbonate of ammonia, probably effected through the medium of a ferment converting the urea into a volatile alkali. Again, mucus altered by an unhealthy condition of the mucous membrane may effect the conversion of urea into an alkali; so may also the presence of a fixed alkali, such as the phosphate of soda, produced during digestion. Dr. G. O. Rees maintains that the alkali which causes the precipitation of the phosphate is secreted by the mucous membrane of the bladder; the earthy salts are precipitated from the urine, and not secreted from the mucous membrane, as was formerly supposed. The treatment of such deposits will be the removal of all recognizable causes, such as imperfect digestion and assimilation, improving the patient's powers, and correcting the morbid conditions of the kidneys and mucous membrane of the bladder.

7. The *carbonate of lime* deposits are of rare existence, generally of secondary formation, and usually occurring in an amorphous form. Under the microscope they appear as small and delicate crystalline spherules. These often congregate together, and assume the shape of a drumstick. The deposit is stated to be the result of such a state of enervation, that the bond of affinity, which in a healthy condition of the nervous system keeps firmly united the elements of urea, becomes loosened; a rearrangement of atoms occurs, the urea becomes carbonate of ammonia, and, under the influence of ordinary chemical affinity, carbonate of lime is generated at the expense of the calcareous salts of the urine.[1]

Having thus taken a cursory survey of the formation of deposits due to changes in the urinary fluid, we now pass on to the more aggravated conditions, viz., the amalgamation or concretion of such deposits into a mass, forming a stone or calculus. The formation of a calculus, in a practical point of view, may be attributed to one of three causes: 1st, it may take place in the secreting cells of the kidney, by precipitation of the salts, such as occurs naturally in the kidneys of reptiles and birds; 2d, it may form in the bladder itself without renal origin, from immediate primary precipitation, in consequence of stagnation of urine in the bladder or otherwise; and 3d, it may be produced by the presence of a foreign body in the bladder, whether introduced from without, or existing within in the shape of coagula of blood, fibrin, etc., which leads to abundant precipitation.

When once solid particles of any substance aggregate and form a mass in the bladder, they very readily induce crystallization of uric acid, oxalate of lime, or triple-phosphate; or a deposition of urate of ammonia, phosphate of lime, or other amorphous ingredients, according to the lesion of function, the state of irritability or innervation present, and the condition of the bladder.

The simplest mode of witnessing the early formation of a stone is in cases where a gum-elastic catheter has been allowed to remain in the bladder for some time, when, on its removal, urinary crystals and deposits are found encrusted upon it. Foreign bodies, no matter of what nature, when present in the bladder, cause decomposition of the urine, and a ready deposition of its salts upon it. Solid substances irritate and inflame the mucous membrane of the bladder, and this, as Dr. Rees[2] observes, causes the latter to secrete a quantity of alkaline fluid, which comes in contact with the earthy phosphates, and is precipitated around the foreign body. Soft substances, on the contrary, such as mucus, fibrin, etc., do not irritate the mucous coat, but cause a precipitation of the ordinary salts of the

[1] Guy's Hospital Reports, series i., vol. vii., p. 224.

[2] Croonian Lectures, p. 23.

urine around them, viz., the uric acid, urates and oxalates, and thus form stone.

Another, and by far the most frequent, cause in the formation of a vesical calculus is the escape from the kidney of a stone, which cannot pass with the urine through the urethra, and which acts in fact as a foreign body, and receives depositions on its surface. Renal calculi[1] are for the most part composed of uric acid or urate of ammonia, less frequently of oxalate of lime, rarely of triple-phosphate of ammonia and magnesia, and, in some cases of diseased kidney, of phosphate of lime. Dr. Prout is led to believe that the uric acid calculus of the kidney is secreted by one of its mammillary processes in a semifluid state, that it afterwards becomes hard, the semifluid mass contracting in bulk as the hardening process continues. Others maintain that the calculus is formed by direct precipitation of the salt. If an excess of uric acid be separated by the kidneys, crystals of uric acid are thrown down; the latter may also be derived from decomposition of the urate of ammonia—the more ordinary source.

The oxalate of lime calculus of the kidney, according to Dr. Prout's researches, is not generated in a perfectly healthy kidney, and two conditions are necessary to its formation: the first, that the oxalic acid should exist in the system, and be secreted with the urine; the second, that lime, in some shape or another (that is, the phosphate or carbonate), shall be furnished by the mucous membrane of the infundibulum. The triple-phosphate of ammonia and magnesia is rarely deposited in the kidney, but it may form a coating for the other calculi, if lodged for a considerable time in the organ. Its formation, according to Dr. Prout, takes place in the following manner: the urine, under ordinary circumstances, contains the phosphate of magnesia, which is held in solution, being a highly soluble salt. But in some cases of disease the urea of the urine becomes decomposed in the kidneys, and ammonia is evolved, which combines with the phosphate of magnesia so as to make the triple salt. [Practically, the existence of triple phosphate crystals in the kidney means the previous existence of chronic pyelitis in that organ. The same truth which is evident in regard to the bladder, is equally so for the kidney, namely, earthy phosphates may be present in excess, and may precipitate within the bladder during long years, but phosphatic stone never forms on that account, and is not to be dreaded so long as there is no chronic inflammation of any part of the urinary mucous membrane in contact with which the urine lies. When chronic inflammation occurs, then decomposition of urine follows shortly, triple phosphate crystals form, the mucous membrane furnishes the necessary colloid, and stone-formation is a natural sequence.]

Dr. Beale[1] observes: "It is not uncommon to meet with microscopic uric-acid calculi; aggregations consisting of uric acid crystals, which if retained might receive deposits of fresh material on the outside, until small calculi, varying in size from a mustard-seed to that of a pea, or larger, are formed. Microscopic calculi of phosphate of lime are by no means uncommon, and are often found in the kidney; but until a few years ago I had never had an opportunity of watching the formation of calculi composed of oxalate of lime. The nucleus of these calculi does not consist of mucus or epithelium, as in the phosphatic, but is of the same composition as the exterior."

The formation of a calculus in the bladder without any previous nucleus of renal origin, or the presence of a foreign body, is due, either to an excess of insoluble material and the immediate precipitation of the salts of the urine—as in the ordinary forms of uric acid, urate, and oxalate concretions—or to stagnation of the urine in the bladder, in consequence of paralysis, hypertrophy, chronic inflammation, and catarrh of the organ, as well as diseased prostate and urethra.

Von Walther[2] maintains that lithogenesis is to be considered as a medium between chemical crystallization and organic growth, and that it has always a greater disposition towards the latter. Wetzlar[3] does not consider that animal gluten is necessary for the production of stone; that urinary calculi are in no respect organic bodies. Some erroneously attribute their formation to fermentation.

The whole of the chemical constituents of a stone require to be held together by a kind of cement, which is believed to be derived from animal matter, either mucous, fibrin, or fatty matter; and some affirm that it may be blood, epithelial scales, or even pus. Mr. Coulson (in his work on Diseases of the Bladder, p. 343) thus sums up: Marcet referred it to the mucous secretions of the bladder; Fourcroy and Vauquelin to albumen, and sometimes to gelatine with an admixture of urea; Berzelius, however, could not determine whether it was composed of fibrin, albumen, caseous matter, or mucus; Brande considered it to consist of a mixture of gelatine with urea; Scharling holds "that the smaller calculi are always

[1] Brodie, On the Urinary Organs, p. 223.

[1] On Urinary Deposits, 2d edit., p. 392.

[2] Journal für Chirurgie, vol. i.

[3] Beiträge zur Kenntniss des menschlichen Harnes, 1821.

enveloped by a layer of mucus, albumen, or some other organic matter, the flocculi of which entangle, and ultimately determine the crystallization of the more insoluble ingredients of the urine;" and Dr. Hoskins, as quoted by Gross, extends this view to the minutest particles of the concretion; he found that the pellicle of transparent animal matter enveloping the particles, when completely divested of salts, bore a great resemblance to epithelial scales; he also frequently detected in the central parts of calculi a large proportion of epithelial scales from the bladder and kidney, with fibrinous casts from the uriniferous tube.

[Carter (The Microscopic Structure and Mode of Formation of Urinary Calculi, London, 1873) finds that uric acid is uncommon in India as a nucleus of urinary calculus. Globular urates and oxalate of lime were most commonly discovered as nuclei in the calculi examined microscopically by him. He believes that the nuclear formation is a special spheroidal and laminar combination of uric acid, oxalate of lime, etc., with a colloid substance (mucus, blood, etc.) which colloid forms an organic parenchyma, as it were, to the whole stone. Carter's views are founded mainly upon Rainey's ideas of "molecular coalescence" and upon the interesting results of Ord's experiments upon the forms of organic matter.

Ord's views, which are full of scientific interest, have appeared in The Quarterly Journal of Microscopic Science, 1872; Monthly Microscopic Journal, March, 1875; Medico-chirurgical Transactions, London, 1875, p. 165, and, most completely, in book form: The Influence of Colloids upon Crystalline Form and Cohesion, W. M. Ord, London, 1879.]

Urinary calculi may be arranged, like the deposits, into two distinct classes, to which a third may be added, comprising the rarer forms. The first will include calculi of uric acid and the urates, with their modifications, the oxalates, uric oxide, and cystic oxide; the second, the phosphatic calculi, embracing all the varieties of phosphates; the third will consist of the rare calculi of carbonate of lime, the fibrinous, the uro-stealith, and the silicious formations. Although these constitute the essential elements of calculi, yet there are other chemical ingredients present in more or less quantities; such as organic matters, carbonate of magnesia, silica, oxide of iron, benzoate of ammonia, oxalate of ammonia, phosphate of iron, urea, clay-mica, etc.

The number of urinary calculi present varies; the renal are generally two or more, the vesical usually only one, and the prostatic very numerous; the vesical, however, may amount to 117, 242, 307, 678, and even to 1000, as stated by Dr. Physick.[1]

[J. R. Macgregor, of New York, has recorded[2] the rather remarkable history of a case of renal calculi in which there were removed from a woman *post-mortem* five hundred and twenty calculi, varying from the size of a mustard-seed to that of an almond, and one large stone, the greatest circumference of which was $16\frac{5}{8}$ inches and the weight 51 ounces. This woman had previously voided by the urethra upwards of three hundred calculi, from the size of a shot to that of a large bean. All these calculi came from the left kidney, which had become misplaced downwards, and occupied the pelvic cavity, so that the stones during life could be felt through the bladder wall.]

The size also is extremely variable, viz., from that of a pea, nut, or almond, to a cricket-ball; the phosphatic calculi usually attain the largest size.

The weight depends not so much upon the size as the composition of the stone, for the phosphatic are very light, and the oxalates very heavy; it may vary from a few grains to many ounces. The majority are under an ounce; the heaviest on record was 6lbs. 3ozs.[3] Recent calculi are heavier than old, as containing moisture.

The shape is not uniform, depending greatly upon the situation and composition of the stone; thus renal calculi are irregular, and often moulded to the form of the calyces, pelvis, and infundibulum of the kidney; those in the ureter are generally cylindrical; the vesical are more regular and of an ovoid form; the prostatic numerous, small and facetted, or pea-shaped. Again, uric acid and urate of ammonia calculi are generally smooth and regular; the oxalates tuberculated like a mulberry, hence the latter appellation; the phosphates irregular and contorted. But there are an infinite variety of forms, such as conical, pyramidal, triangular, cubical, square, rhomboidal, reniform, pisiform, cardiform, cuneiform, semilunar, etc. Some appear as if they had been actually divided by a firm cutting instrument; and in one case, in the Guy's Museum (No. 2136[50]), the apparently divided portions seem as if they had again become cemented and framed in by a subsequent deposit. [The spontaneous fracture of stone sometimes occurs in the bladder. Ord (Trans. Lond. Path. Soc., vol. xxviii., p. 170) explains this on the assumption that the nucleus is formed of some colloid substance with the urine of a certain re-

[1] Gibson's Institutes, 5th ed., vol. ii., p. 220.

[2] Am. Journ. Med. Sci., Jan., 1877, p. 120.]

[3] Coulson, op. cit., 5th ed., p. 337.

action or density. Later the reaction of the urine may change, causing the colloid cement to swell, and thus burst the outer concentric layers of deposited stone. With this paper specimens were shown justifying the hypothesis. At a later meeting of the society, other specimens were exhibited by Mr. Ord—vol. xxix., p. 161; and again later—vol. xxx., p. 314–320—the specimens in this case having been forwarded from Carlsbad by Dr. Kraus.] In the same collection (No. 2145[35]) there is a cystic oxide calculus in the shape of an ear-drop. Some remarkable forms of calculi have been detailed in the Guy's Hospital Reports, series iii., vol. iii., p. 351, where the appearance resembles that of two calculi united by a transverse bar, from which circumstance they are termed barshot or dumb-bell shaped calculi; these forms are generally met with in calculi which have originated or become lodged in the prostate, and grown backwards into the bladder. Such shapes have also been found in encysted calculi of the bladder.

The color of a calculus depends for the most part on the chemical nature of the crust or surface, but this by no means indicates the actual nature of the interior of a calculus: a white surface shows a phosphatic crust; a cinder-gray, that of urate of ammonia; a yellow pale-brown, or brown, the uric acid; cinnamon-brown, the uric or xanthic oxide; a brown, brownish-green, or even blackish-green, the oxalate of lime; a gray-greenish hue, the cystic oxide. These colors, however, are liable to modification, and give but presumptive evidence.

The odor of recently extracted calculi is sometimes peculiar. The phosphatic calculi are very ammoniacal, fetid, and acrid; oxalate of lime calculi on section are said to emit a faint odor of semen. Some are affirmed to possess an aromatic smell, like that of castor or musk.

The consistence depends in a measure on the chemical composition, on the amount of cohesion of the particles, and on the presence of moisture or organic matter: it varies from that of soft mortar or sand to that of hard marble. Phosphatic calculi are generally soft, the uric acid hard, and the oxalate very hard. The crust is usually the softest part of a stone, and the nucleus the most dense. A stone of rapid formation is less dense than one of long existence and of small size.

The section of a calculus shows its internal construction, and ordinarily presents a centre or nucleus, a body or intermediate part, and a crust or outside coating. When all these consist of one and the same chemical material the calculus is called uniform or simple; when it is made up of one or more elements, the stone is termed mixed, heterogenous, or compound. Again, these elements may be so disposed as to form a solid mass, without any visible distinction of arrangement; but generally they are deposited in concentric layers or laminæ, and in some instances there are seen lines radiating from the centre to the circumference, as if the laminæ were composed of perpendicular crystalline fibres. Prout[1] thus explains the laminated condition: "Between the different intervals at which the different laminæ have been formed, periods have intervened during which no deposition has taken place. This remark not only applies to the different laminæ of a heterogeneous calculus, but to the different laminæ of calculi composed of the same substance; as, for instance, to the different laminæ of which lithic acid concretions usually consist. This explanation is in perfect accordance with the circumstances attending the formation of calculi, which often, as is well known, remain in the bladder for a great number of years without attaining any remarkable size. Moreover, the constant state of change alone, to which the urine in all individuals is liable, almost precludes the notion of homogeneity in a calculus. We may suppose, therefore, that certain changes take place in the urine, during which the law of continuity of deposition is suspended, and the surface of the concretion becomes, as it were, *water-eaten*, and less apt for future accretion; in short, assumes all the properties of a heterogeneous substance. Under these circumstances, when a tendency to deposition occurs, it will have to commence *de novo*, and, as it were, on the surface of a foreign body. The consequence will be, that the adhesion between the new and the old coats or laminæ will be less firm than in the intermediate parts, and that a calculus thus formed will be disposed, when broken, to separate into concentric laminæ."

Dr. Hodgkin[2] gives the following account of the *Structure and Character of Calculi*:—

A. *Calculi of a Crystalline Character.*—In many instances, the particles separated or precipitated from the urine to form calculi, assume a crystalline character; and the mode in which this crystallization takes place around a small nucleus materially influences the structural character and the form of a calculus. The structure is radiated, and the form more or less rounded. Such specimens of calculi bear considerable analogy to certain zoolites, and to some specimens of radiated

[1] Prout, On Gravel, Calculus, etc., p. 361.

[2] Guy's Hospital Reports, series i., vol. ii., p. 268 et seq.

quartz. The cystic oxide affords one of the best specimens of decidedly crystalline calculi. Some of the phosphates appear to come next; and calculi consisting of oxalate of lime frequently present evident traces of crystallization.

B. *Amorphous or Massive Calculi.*—The molecules which unite in the composition of these calculi do not possess a perceptible crystalline form, and the resulting substance is what the mineralogists would call massive, with no other indication of structural arrangement than more or less distinct traces of superposition in concentric layers. There is considerable variety in calculi of this description; some possessing granular texture, which might be compared to a coarse sort of sandstone, whilst in others it is soft and earthy, like some of the softest specimens of chalk or tufa. The lamellar arrangement is very differently perceptible in different specimens; in some it is strongly marked, and the calculi, which are easily crushed, separate in shell-like flakes; whilst others, in which the arrangement is less conspicuous, break up almost indifferently in all directions.

C. *Calculi Intermediate between Crystalline and Amorphous.*—These are such as present a mammillated surface, and on close inspection of a section or fracture appear to have their several lamellæ made up of short fibres, at right angles to the plane of the lamellæ. These are often an assemblage of acicular crystals. This form of calculus is most frequent in those specimens which are composed wholly or chiefly of oxalate of lime.

It is not unfrequent to meet with a model calculus, viz., the nucleus formed of uric acid or urates, as urea is the chief constituent of healthy urine; the body composed of oxalate of lime, which latter Dr. G. O. Rees regards as uric acid or urates altered after secretion; and lastly, the crust formed of phosphates, the result of irritation. When a calculus consists of different layers, one deposit succeeding another in a regular manner, it is called *alternating*. (See Plate, fig. 9.)

For a careful analysis of the condition and relative proportion of the constituents of urinary calculi, as regards the nucleus, body and crust, we must refer the reader to the standard works on urinary calculi, and more especially to the Catalogue of Calculi in the Museum of the Royal College of Surgeons of England, in which work also there are excellent colored plates of all varieties of calculi. In general, calculi are classified according to the apparent nature of the nucleus; and for the present this nomenclature is adopted, although Dr. Beale[1] points out a fallacy when he states that it is important to bear in mind that the central part of the calculus which is visible to the unaided eye is spoken of as the nucleus, while the real nucleus may be microscopic, and of a different composition to the material which immediately surrounds it. The nucleus of many calculi, which apparently consists of uric acid, is really composed of oxalate of lime, around which the uric acid has been deposited.

The nucleus, according to Dr. G. Bird's[2] observations, is usually found in the geometric centre of the calculus, or nearly so; but it is occasionally remarkably eccentric, as in some reniform concretions; and in a few, several distinct nuclei, or centres of deposition, are met with. In some rare instances, the concretion which forms the nucleus is found loose within the body of the entire calculus; a circumstance, in all probability, arising from a layer of blood or mucus having concreted around the nucleus, and the matter forming the body of the calculus having been deposited on this layer. In this case, on the whole becoming dry, the mucus or blood would be diminished to a very thin film, and the calculus would appear to contain a loose nucleus. In a few instances calculi appear to possess no nucleus, the centre being occupied by a cavity full of stalactites or mammillated projections, giving the idea of the external layer having been first formed, and the mammillated portions subsequently in the interior. In the Museum of Guy's Hospital this state occurs only in the uric-acid calculi. In one specimen in the collection (No. 2154) the central cavity is lined with fine crystals of triple-phosphate, resembling the crystals of quartz so often found lining cavities in flints. The explanation of the formation of such cavities is, that the original nucleus was either blood or mucus, which has disappeared by desiccation.

Although in an essay of this kind we cannot enter fully into the chemical analysis of urinary calculi, yet we have deemed it advisable to introduce the following oft-quoted table of Dr. Bence Jones,[3] somewhat modified:—

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[1] On Urine and Urinary Calculi, 1861, p. 354.

[2] Guy's Hospital Reports, series i., vol. vii., p. 182.

[3] Medical Times, October, 1851.

Urinary Calculi.

A. Destroyed by heat; combustible; leaving only a small residue:

1. Become red on the addition of nitric acid, and form a murexide:

a. Soluble in carbonate of potash, evolving *no* ammonia; soluble in caustic ammonia, or potash; on the addition of an excess of acid crystallizes in angular crystals; not soluble in water	Uric acid.
b. Soluble in carbonate of potash, evolving ammonia; soluble in water when boiled; solution in water with a few drops of ammonia, when evaporated, crystallizes in needles	Urate of ammonia.

2. Do not become red on the addition of nitric acid.

a. Soluble in ammonia, *not* crystallizing when evaporated; insoluble in carbonate of potash; dissolves without effervescing in nitric acid, leaving a lemon-colored residue; soluble in strong sulphuric acid, not precipitated by dilution	Uric or xanthic oxide.
b. Soluble in ammonia, crystallizing in six-sided plates when evaporated; soluble in strong caustic potash; the solution, when boiled for a few moments, on the addition of a drop of dilute acetate of lead, gives sulphuret of lead	Cystic oxide, or cystine.
c. With difficulty soluble in ammonia, not crystallizing; with nitric acid becomes bright yellow; solution in caustic potash precipitable by acetic acid in an amorphous form; emits an odor of burnt feathers on ignition	Fibrinous.

B. Not destroyed by heat; non-combustible; leaving a considerable residue:

1. Soluble with hydrochloric acid; effervesces *before* heating; soluble in mineral acids with effervescence; solution in acid, when neutralized, gives a precipitate with carbonated alkalies and oxalate of ammonia; soluble in dilute acetic acid, with effervescence . . . . . — Carbonate of lime.

2. Soluble with hydrochloric acid; effervesces *after* heating; soluble in mineral acids without effervescence; solution in acid when neutralized gives a white precipitate with carbonated alkalies and oxalate of ammonia; insoluble in acetic acid; decomposed by strong sulphuric acid, yielding carbonic acid and carbonic oxide; and when boiled with carbonate of soda, oxalate of soda is formed in the solution and precipitated by chloride of calcium . . . — Oxalate of lime.

3. Soluble with hydrochloric acid; does *not* effervesce either *before* or *after* heating:

a. Solution in acid with excess of ammonia gives a white *crystalline* precipitate; with half its bulk of phosphate of lime (bone-earth) is very fusible before the blowpipe, and gives off an ammoniacal odor; dissolves in acetic acid without effervescence	Phosphate of ammonia and magnesia.
b. Solution in acid with excess of ammonia gives an amorphous precipitate; with twice its bulk of phosphate of ammonia and magnesia is very fusible before the blowpipe	Phosphate of lime.
c. Solution in acid with excess of ammonia gives a white, partly crystalline, partly amorphous, precipitate; without addition easily fusible before the blowpipe .	Mixed phosphates.

4. Not acted upon by acids or alkalies; fused with twice its bulk of carbonate of soda forms glass . . . . . — Silica.

We will now give a general description of each variety of calculus.

1. The *uric-acid calculus* is the most frequent, and was discovered by Scheele in 1776 (see Plate, fig. 1). Calculi composed entirely of uric acid in the several collections bear the proportion to all other calculi as 1 to 4 and 5; and, as a nucleus in compound calculi, from 1 to $1\frac{1}{4}$ and $2\frac{1}{3}$. The color is generally light brown, yellowish-brown, or brownish-red, but may vary from pale fawn to a rich brown, and may sometimes resemble old mahogany or polished oak; the surface may also be coated with a crust of amorphous urate of ammonia or phosphate of lime, giving a white appearance; and the nucleus, although consisting of pure uric acid, ac-

cording to Dr. G. O. Rees, may be quite white, owing to the absence of coloring matter. The size varies greatly, and it often attains considerable bulk: the weight and specific gravity is intermediate between the oxalate and the phosphate; the form is generally ovoid, laterally compressed and smooth, but sometimes beset with small tubercles, which may be increased to such an extent as to make the stone resemble the oxalate of lime:[1] the calculus may also mould itself into irregular shapes in the locality in which it may be placed. The appearance on section varies extremely; Dr. Thudichum[2] describes it to consist of concentric layers of variable thickness, every layer preserving its own thickness pretty regularly all round the calculus; the texture is best seen on the surface; in the hard and pure varieties it is crystalline and fibrous, the fibres of each layer converging like radii towards the centre of the stone, and their fracture being almost parallel with those fibres; the less dense and pure calculi are of a more earthy character and amorphous in fracture, having no laminæ. Some few are so hard as to impart a ringing noise on percussion, a sharp sound like a pebble. Here the fracture is conchoidal, and such stones when broken, as in lithotrity, form sharp angular fragments, which are dangerous from their tendency to wound the bladder and urethra.

2. The *urate-of-ammonia calculus* is not common; it was discovered by Fourcroy and Vauquelin in 1798 (see Plate, fig. 2). In the Museum of the Royal College of Surgeons, Edinburgh, there are only 14 in 649 calculi, being 1 in 46; at Guy's Hospital Museum there are 7 in 394: but this substance forms an important constituent of compound calculi, varying from 1 in $3\frac{1}{4}$ to 1 in $7\frac{1}{2}$ of all calculi. The calculi are seldom large, rarely exceeding an inch in size, are generally ovoid and smooth, or sometimes slightly tuberculated on the surface. Their color is very generally characteristic, being of a slate, pale grayish-fawn, or clay color; not unfrequently they more nearly resemble pipe-clay in tint; sometimes there is an admixture of red or brown, and in rare instances pink layers are observed near the centre. In the Guy's Hospital Museum (No. 2213) there is a remarkable collection of 142 calculi removed from the bladder of one patient by Sir Astley Cooper, all of the same figure, being cubes rounded at the edges and angles; these have the color of pipe-clay, and are chiefly composed of urate of ammonia: it is curious that the patient had afterwards another calculus, which on examination proved to be of a different kind from these. Their consistence is usually compact, earthy, and very brittle, and they have a fine earthy fracture; this is well shown in a calculus (Guy's, No. 2136[50]), where there is a remarkable fissure running through it, as if it had been fractured and subsequently reframed by a deposit of urate of ammonia. They seldom present the distinct concentric arrangement of uric-acid calculi, generally appearing homogeneous, but at times an indistinct thin laminated condition may be traced; this circumstance is readily explained by the frequent amorphous condition in which the urate is deposited in sediments. These calculi are generally observed in children, and are said to give rise to little constitutional disturbance.

Calculi of urates of soda or lime are not met with; the salts are generally mixed with those of urate of ammonia or uric acid in the several layers of compound calculi. In one instance, however (Guy's Hospital Museum, No. 2154[95]), there is a fusible calculus with a nucleus of urate of lime.

3. *Uric oxide, or xanthic oxide, or xanthine*, discovered by Dr. Marcet in 1815, is a very rare calculus, of which only four specimens are recorded (see Plate, fig. 5).

The calculus in which Dr. Marcet first detected this substance weighed but eight grains, and nothing is known regarding the portion not consumed in the analysis: it does not exist in the collection at Guy's Hospital, and neither Dr. Prout, Dr. Yelloly, nor Dr. Babington can give any information on this point. It was rediscovered by Dr. Stromeyer;[1] the calculus was removed by Langenbeck from a peasant's child, eight years of age, at Hanover. In shape it resembled a flattened pullet's egg; it broke into three pieces during the operation. The whole calculus weighed nearly 339 English grains; its section was partly of a lustrous bright brown color, and partly earthy and pale brownish flesh color. It was composed of concentric separable layers, without any appearance of a crystalline or fibrous texture; it possessed a distinct nucleus, which did not, however, differ in chemical characters from the body of the calculus. It was as hard as uric-acid calculi generally are, and on slight friction it assumed a wax-like lustre. Professor Merx, of Göttingen, sent two fragments of the calculus to Dr. Willis, one of which is in the Museum of the Royal College of Surgeons, Edinburgh, and the other is in the Guy's Hospital Museum (No. 2145[90]). In the Catalogue of Calculi at the College of Surgeons of England there is a plate of this calculus (see Plate xii.).

The calculus bears a close relation to uric acid, and seems to depend on an im-

[1] See preparation No. 2125, Guy's Hospital Museum.

[2] Thudichum, On Urinary Deposits, etc., p. 111.

[1] Annalen der Physik, Band 41, p. 393.

perfect oxidation of the material from which, by the ordinary processes of the kidney, uric acid is eliminated.

4. The *oxalate-of-lime calculus*, discovered by Wollaston, in 1797, is the next most frequent after the uric-acid calculus, and bears the ratio of 1 in 14½ to 1 in 20 of other calculi. These calculi do not generally attain a very large size, but are very compact, dense, and proportionately heavy. As a nucleus in compound calculi, its proportion varies from 1 in 4¾ to 1 in 7½ (see Plate, fig. 4).

Dr. G. Bird[1] thus describes these calculi: Their form or external configuration is almost invariably that of a tubercular, angular, or spinous character, and rarely perfectly smooth, which, together with their color, varying from gray to a rich brown or almost black, has gained for them the specific name of "mulberry." In some calculi the surface is studded with spines so acute and slender as to resemble thorns; in others there is a coating of acute octahedrons of transparent oxalate of lime, giving an extremely beautiful appearance. Sometimes these crystals are opaque, and the octahedron is remarkably flattened: the calculous then looks as if studded with pearl-spar.[2] Dr. G. Bird observes: "It has been supposed that the spinous and irregular form of these calculi depends upon their being formed in the kidney, and that they were casts of the pelvis and calyces of the organ. This, however, is by no means sufficient to account for their figure; for no calculus so closely becomes a cast of the interior of the kidney as the fusible variety, and yet this ever presents a tolerably smooth surface, however contorted in figure. It is, therefore, more likely that the constantly crystalline state in which the deposit of oxalate occurs has more to do with it; and without calling to our aid any very fertile imagination, a tendency to a cubic or octahedral outline can often be traced to the entire calculus." Sometimes these intervals between the projections or spines are filled up by some amorphous substance, as urates, or phosphates, thus giving the whole an ovoid character. The appearance on section is generally that of an imperfectly lamellated structure, the consecutive layers forming waving lines, and often resembling knotted heart of oak; occasionally there is seen a layer of oxalate of lime arranged round the interior one with great regularity, having a remarkably radiated appearance, like a series of infinitely minute needles placed side by side, and presenting a perfectly porcellaneous structure. In compound calculi the oxalate of lime deposition gives to the character of a stone a remarkably beautiful appearance resembling that of fortification agate.

The rarer varieties of oxalate-of-lime calculus are the following:—

1st. The small, smooth, globular "hempseed calculus" described by Dr. Wollaston, and thus alluded to: "It is of a much lighter color, so as to resemble in hue as well as smoothness the surface of a hempseed." There may be one or many, and they are generally found in the kidney.

2d. Where the character of the calculus is crystalline throughout, and it has a white or pale brown color. These calculi consist of nearly pure oxalate of lime in a crystalline form. Dr. Yelloly, on analyzing the calculi in the Norwich Hospital Museum, met with not less than twenty examples of such crystallization. The author has removed by lithotomy a calculus consisting of pure oxalate of lime, and of a pale brown color, which crumbled to pieces immediately after extraction, a circumstance which was due to the absence of any binding material, there being no trace of animal matter.

The third variety is the pure white oxalate-of-lime calculus. This is of a milk-white color, possesses a highly polished surface, is of extreme rarity, and is generally, if not always, found in the kidney; its external surface presents no crystals, but is perfectly smooth, though it may be spinous.[1] This variety seems to have escaped the attention of writers on stone.

In the Museum of the Norfolk and Norwich Hospital are three specimens: the first, a moist preparation representing a renal calculus of cauliflower shape and of great magnitude; it occurs in the form of a single mass, filling a greatly distended pelvis. From this mass there branch out other smaller masses, which fill up the infundibula. The whole kidney is greatly enlarged. The stone is extremely white, quite smooth, very hard and compact, and polished; it resembles Parian marble. The only circumstance known of its history is, that the preparation was removed from a man after death.

The second example is a small calculus, very smooth and shining, weighing ten grains, about the size of a horse-bean, said to have been passed by an adult female. On analysis it yielded oxalate of lime.

The third specimen is nearly spheroid in shape, and about the size of an ordinary marble; it is of a white color, though not so polished as the above two are; its external

[1] Guy's Hospital Reports, series i., vol. vii., p. 213.

[2] See Preparation 2139[25] in the Guy's Hospital Museum.

[1] For the detailed account of this variety we are indebted to Mr. Charles Williams, formerly House-Surgeon to the Norwich Hospital.

surface is covered with spines and tubercles peculiar to the "mulberry calculus," which it most clearly resembles in everything but color. Its tubercles are smooth, *i. e.*, they are devoid of crystals; its weight is forty-five grains. The catalogue informs us it was passed by a female, aged twenty, who was pregnant at the time. On scraping its surface, and placing the debris under the microscope, very minute octahedra of oxalate of lime were detected; they were insoluble in potash and acetic acid, and thus distinguished from other substances which they resemble.

In reference to this Mr. Williams remarks: "I am inclined to believe that the pure white color of the third variety of oxalate-of-lime calculus is due to the circumstance that it is met with only in the kidney, and that while in that organ it is not permitted to lie continuously in urine, and therefore cannot acquire the dark brown or almost black hue which the oxalate-of-lime calculus generally assumes when situated in the urinary bladder. The tuberculated form of this calculus, in consequence of its roughness, causes the mucous membrane of that viscus (the bladder) to pour out blood far more frequently than any other variety of calculus; and there can be but little doubt that the color is derived from the hæmotosin, which has been abstracted by the urine from the blood-corpuscles, and remains suspended in it."[1]

While in the kidney, the constant trickling of urine over this variety of stone gives rise to its smooth white surface.

5. The *cystic oxide, or cystine calculus*, discovered by Wollaston in 1810, is a rare calculus (see Plate, fig. 3). It differs from all others in containing a considerable proportion of sulphur, no less than two atoms being present in every equivalent of the oxide. The calculus is not a product of the bladder, as its name would seem to imply, but of the kidneys; and there is a remarkable hereditary disposition to its formation, for out of 22 collected cases, 10 occurred in four families, and in 3 cases the subjects of the complaint were brothers. Ten specimens in the collection of Guy's Hospital were passed by the same patient, whose age was 30; 3 were passed in the year 1814 (No. 2144), 6 small ones subsequently (No. 2145), and in 1828 another remarkable one, of the shape of an ear-drop (No. 2145[35]).

These calculi are usually small in size; the largest is in the University College Museum, and weighs 850 grs.; at St. Bartholomew's there is one weighing 740 grs. The one at Guy's Hospital (No. 2143), the second specimen analyzed by Dr. Wollaston (the discoverer), is described by him in the Phil. Trans. for 1810; it is an inch and a fifth long and one inch broad.

They are described to be generally rounded and smooth, but may be covered either with smooth tubercles or sharp projections externally; they have a wax-like lustre, appear semi-transparent and glistening, and resemble very much the ammoniaco-magnesian-phosphate calculus. When recent, their color nearly approaches that of the uric-acid calculus, being of a pale yellowish-brown; they undergo, however, a remarkable change by long keeping, turning slowly from brown to gray or green. Thus the calculus in Guy's Hospital Museum (No. 2143) was brown in 1817, now it possesses a rich bluish-green color. Some consider that the greenish-blue or dirty-green color is due to the presence of earthy phosphates. Dr. Bird, however, remarks: "It has been suggested to me by both Dr. Prout and Dr. Willis, that this alteration in tint may in some way depend upon changes produced by the sulphur." Their consistence is soft, and on section they present a very imperfectly radiated structure, and exhibit no tendency to a development of concentric layers; when scraped, they yield easily to the knife, and form a perfectly white powder, whether the calculus be brown or green. The fracture is crystalline.

6. The *phosphate-of-lime calculus*, discovered by Wollaston in 1797 (see Plate, fig. 6), is likewise rarely found in the bladder uncombined with other salts; and it seldom forms the nucleus of other calculi. Calculi chiefly or entirely composed of it are tolerably hard and smooth externally, not presenting the angular asperities of the oxalate of lime, or the contorted and irregular figure frequently assumed by the fusible calculus; sometimes they consist of two or three portions fitting into each other in a variety of ways.

Of three specimens in the Guy's Hospital Museum, the first (No. 2148) presents a porcellaneous appearance externally, admitting of considerable polish by friction; is conchoidal in its fracture, and is of a grayish-white color; the second (No. 2149) is more regular in figure, and is made up of a series of concentric layers of the phosphate, readily distinguished from each other by their tint, being alternately white and fawn-colored; the third (No. 2150) is light-colored, and has a spongy, cancellated structure, and looks more like a bony concretion than a deposition.

There are, however, two varieties of this form of calculus: the one, as described by Wollaston, of renal origin, and consisting of neutral phosphate of lime;

[1] Hemorrhagic urine, filtered so frequently as to lose all the corpuscles, will be found to possess the dark blood-stained color notwithstanding.

and these are usually pale brown, with a smooth polished surface regularly laminated, and the laminæ so slightly adherent as to be easily separable into concentric crusts; in some, radiating lines are seen in a direction perpendicular to the laminæ; these calculi contain a considerable proportion of animal matter. The other form is of vesical origin, and composed of phosphate of lime, similar to that of bones, and hence often called "bone-earth" calculi; they are more common than the former, and constitute irregular masses resembling mortar, or a granular semi-crystalline powder, enveloped in a tenacious mucus. Dr. Taylor, in the Catalogue of Calculi of the Royal College of Surgeons, England, has described some specimens as consisting entirely of this salt.

The phosphates are scarcely ever succeeded by any other form of calculus, but there are three instances in which a phosphatic calculus was succeeded by uric acid or urate of ammonia, and in one instance it was followed by oxalate of lime; the general ratio in which they succeed other deposits is 1 to $4\frac{1}{5}$. Foreign bodies as a rule have earthy phosphates deposited upon them; but there is one remarkable exception (Cat. of the Royal College of Surgeons of England, Plate iv., fig. 6) where a slender piece of steel formed the nucleus of a large oval calculus, consisting almost entirely of uric acid.

Respecting the earthy phosphates in calculi Dr. Thudichum remarks:—"Not quite ten per cent. of all calculi have a nucleus of mixed phosphates; but these substances enter into the composition of about 34 per cent. of all calculi, forming either their body, one or more layers, or the crust. This shows that the presence of deposits of mixed phosphates in the urine scarcely ever gives rise to the formation of calculus, but that the presence in the bladder of other calculi frequently cause a deposit of phosphates to be formed around them, in which respect every calculus is nothing else than a foreign body. For such a concretion to form, it requires the presence of some binding material, such as ropy mucus, or a clot of blood or fibrin, in hematuria and chronic disease of the mucous membrane of the bladder."

[Sir H. Thompson has recently recalled attention to this fact, emphasizing the well-known truth that earthy phosphates in the urine, although precipitated and voided freely as a granular sediment during urination, never do and never can give rise to calculous formation, as long as the bladder is healthy. The assistance of a colloid in the form of the ropy mucus deposited in conditions of chronic inflammation by the bladder-walls seems to be necessary in order that the existence of phosphates in the urine shall become a source of stone-formation, and under such inflammatory conditions phosphatic stone may form whether the urine itself be over-rich in phosphates or not.]

7. The *triple-phosphate calculus*, or ammoniaco-magnesian phosphate, also discovered by Wollaston in 1797 (see Plate, fig. 7) is rare.

There are three specimens of this calculus in the Museum of the Royal College of Surgeons of England, and one or two at Guy's Hospital; in the former collection they appear as a white crystalline mass, radiating from the centre, and having the surface studded with shining crystals, which, when recent, are nearly transparent, but by exposure become opaque; their texture is earthy, friable, and imperfectly lamellar; some are hard and compact, semi-transparent, and crystalline in fracture like alabaster. In the Guy's collection (No. 2154) a calculus of this kind is to be seen which has no nucleus, but a central cavity lined with delicate crystals of triple phosphate, resembling the crystals of quartz in the cavities of flints; and No. 2152 is a section of a large calculus of the kind on a nucleus of a tobacco-pipe. Dr. Thompson mentions a calculus of this sort weighing nearly two pounds.

8. The *fusible calculus*, or mixed phosphate, or the phosphate-of-lime and phosphate-of-magnesia and ammonia calculus, discovered by Wollaston in 1797 (see Plate, fig. 8), is the most frequent of the phosphatic calculi, and forms rather more than $\frac{1}{18}$ of all calculi, being rarely succeeded by any other species of urinary deposit; their relative proportions in the several collections are various, from 1 in $8\frac{1}{2}$ to 1 in $13\frac{1}{2}$.

These calculi grow to a considerable extent, and are comparatively light and of low specific gravity; they are generally very irregular, and mould themselves to the situation in which they are placed, often filling the interior of the bladder, and becoming impressed with its rugæ; sometimes they are globular and ovoid, at other times taking on the most extraordinary shapes; where there are two or more, they assume a cubic or tetrahedral form. Their color is white, gray, or dull yellow, and their consistence is more friable and earthy than any other variety, and is sometimes so soft as to resemble moist chalk.

Their appearance on section is thus described by Dr. Taylor (op. cit.): "They are frequently composed of concentric laminæ, which in general adhere but slightly to each other; between the laminæ shining crystals of the triple-phosphate are often observed; in some the laminæ are entirely wanting, and these

form a white friable mass like chalk; in others they appear semi-crystalline, as if made of numerous small crystals confusedly aggregated together. The relative proportion of the constituents of this calculus is exceedingly various, and the predominance of one or the other salt gives peculiar characters; in those which have a crystalline and glistening texture the triple-phosphate is most abundant, while the calcareous phosphate is in excess in those which have an amorphous earthy appearance."

It generally constitutes the calculous masses deposited on foreign bodies accidentally or intentionally introduced into the bladder.

9. The *carbonate-of-lime* calculus, discovered by Brugnatelli in 1819, is a very rare form indeed.

He describes[1] forty-eight small concretions extracted from the bladder of a young man; these were of the size of a pea, lamellar in structure, and broke with a shining fracture. He also mentions several ash-colored calculi, sixteen in number, and of the size of a nut, which were composed of carbonate of lime with a trace of carbonate of iron; these were removed after death from the bladder of a woman. Dr. Prout has also seen small calculi of this salt, and these were perfectly white and very friable.

In Guy's Museum, No. 2182[77], there are some calculi of carbonate of lime, with mere traces of carbonate of magnesia and alumina; in one specimen, No. 2187[50], it constitutes the body of a calculus, being deposited of a snow-white color, on a nucleus of uric acid. There are several in the Oxford Museum, among the collection of Mr. Hitchins, and there is in the possession of Mr. R. Smith, of Bristol, a remarkable collection of these calculi, some of which are figured in the Catalogue of the Royal College of Surgeons of England, Plate xii., figs. 3, 4, 5, 6, and 7. Of these calculi, five were extracted by the lateral operation from the bladder of a boy aged sixteen, and the other fifteen were passed by the urethra previous to the operation; these latter were of the size of peas, of a rounded figure, and had flattened surfaces; they were compact and lamellar in structure, and their external surface was of a light brown color. Those extracted by operation were exceedingly irregular, and their external surface dusted over with white powder; the largest was of the size and figure of a large almond; when sawn through, the concretion showed no concentric laminæ, but irregular waved lines similar to those of the mulberry calculus. The largest was so hard as to require the assistance of the lapidary's wheel to divide it.

Prostatic calculi sometimes consist almost entirely of this substance, but, as Dr. Thudichum observes, "it is always questionable whether the lime or the carbonic acid were in any case derived from the urine."

10. The *fibrinous calculus* of Dr. Marcet and of Dr. Prout is by some not ranked among calculi, in consequence of its differing so totally from those other concretions. Dr. Bird[1] says:—"It must be regarded as a portion of dried inspissated albuminous matter exuded from an irritated kidney, rather than as a calculus produced under circumstances at all analogous to those of other concretions. Several specimens exist in the Guy's Museum of the pelvis of the kidneys and uterus being obstructed by clots of fibrin; but none of them present the hard concrete condition of the calculus described by Dr. Marcet. I am not aware of this variety having been mentioned by any other author except Brugnatelli, who, in his Litologia Umana, describes some calculi as consisting of crystallized albumen; they were passed by one individual, and each was about the size of a nut. These pseudo-calculi appeared to consist of dried coagulated albumen, which not unfrequently presents considerable lustre and a vitreous fracture, although scarcely sufficient to justify its being regarded as crystallized." Some have described it to resemble yellow wax in appearance, and others have regarded it as an elastic organic substance closely allied to fibrin.

11. The *uro-stealith calculus* is another of the pseudo-forms: it is not decided whether it is a resin or fat, and its elementary condition is entirely unknown.

It has been described in Heller's Archives (1844, p. 97, and 1845, p. 1), and it consisted of several small bodies composed of a peculiar form of fatty matter, which were passed by a man aged twenty-four, who suffered from symptoms of stone in the bladder. Dr. Moore, of Dublin, has confirmed the existence of this substance, and has examined several specimens sent to him by Dr. Robert Adams, of Dublin.[2]

12. *Blood calculi* have been but recently discovered, and are likewise pseudo-calculi.

Those described by Dr. Alison[3] were found in the infundibula and pelvis of the kidney of a painter, aged 52, who died of consumption; black calculi occupied the pelvis, while the infundibula were tenanted by a few calculi of a whitish-gray color, with one exception small in size, about the magnitude of pear-seeds, and wanting the ordinary physical characters of phosphate of lime. One

[1] Litologia Umana, Pavia, 1819.

[1] Guy's Hospital Reports, series i., vol. vii., p. 180.

[2] Dublin Quarterly Journal of Med. Sci., May, 1854, p. 473.

[3] Dr. Scott Alison, Archives of Medicine, vol. i., p. 245.

calculus which occupied the infundibulum was the size of a horse-bean, looked somewhat worn and disintegrated, and at one point resembled a piece of decayed wood, and was black on one side from the presence of altered blood; it was very light in weight, and was composed of blood and phosphate of lime. The black calculi, which formed the chief point of interest, were about six in number, and ranged from the size of a coriander-seed to that of a small horse-bean; when found, these black calculi were tolerably hard, but being friable they broke asunder on handling; the fractured surface varied a little in color, in some parts presenting a dark rusty appearance. Liquor potassæ dissolved them, and they were capable of partial combustion; the microscope revealed only amorphous particles, but Dr. G. O. Rees, with the assistance of a neutral saline solution, discovered forms which he considered to be the remains of blood-corpuscles.

Silicious concretions are not met with, although silica has been found in other calculi, by Berzelius, Vauquelin, Fourcroy, and others. Those which have been extracted from the bladder have been pebbles or small stones introduced from without.

There are certain predisposing causes and conditions which are supposed by some to influence the formation of stone, or tend to its production; to these we can only cursorily allude. Thus, respecting climate and locality, it is stated that calculus is more frequent in temperate than in warm and cold regions, but more especially in humid and moist countries of moderate and changeable temperature, such as Holland, France, England, and Germany. It is, however, met with very frequently in Egypt, Isle of France, Bagdad, Russia, and both the Indies. Even in some parts of the same country it is more prevalent than in others, as in Norfolk in England.

[In this country stone is uncommon in New England (Morland, "Diseases of the Urinary Organs," Boston, 1858, p. 387), while it is more frequently encountered in Ohio, Kentucky, Tennessee, North Carolina, Alabama, and Virginia.]

With regard to race, it is asserted that the disease is much more frequent among the white than the dark,[1] and Liebig attempts to explain this by suggesting that the exemption of the people of China from gout and calculus is due to the urine containing large quantities of tartar. However, stone is excessively common among the natives of India.

In some cases it may be traced to hereditary transmission, especially where there is gouty diathesis.

[1 Gross corroborates this view. On the Urinary Organs, Philadelphia, 1876, p. 168.]

The sex modifies the relative proportion, stone being less frequent in females than males, their proportion being 1 to 20 or 1 to 23. This is due to the peculiar anatomical disposition of the urethra in the female, viz., its shortness, and its capability of dilatation allowing the easy passage of a small stone; as also to the comparatively temperate and regular habits of life of females.

The age at which calculi are most frequently met with is said to be in the young and in old people. This can only be ascertained by statistics, which are for the most part imperfect. The table furnished by M. Civiale gives the following results of 5376 cases: Under 20 years of age, 55.56 per cent.; between 20 and 40, 14.69 per cent.; between 40 and 60, 14.95 per cent.; and above 60 years, 14.76 per cent. That of Mr. Coulson,[1] of 3264 cases: Under 20 years of age, 71.20 per cent.; between 21 and 40 years, 12.10 per cent.; between 41 and 60, 10.87 per cent.; and between 61 and 80, 5.72 per cent. That of Sir Henry Thompson,[2] of 1827 cases: Under 20 years of age, 60.42 per cent.; between 21 and 40, 10.18 per cent.; between 41 and 60, 17.56 per cent.; and between 61 and 81, 11.83 per cent.

Sir H. Thompson's cases are derived from the entire experience, during given periods of time, of the following hospitals: Guy's, St. Thomas's, University College, Norwich, Cambridge, Oxford, Birmingham, Leicester, and Leeds. It is quoted in a foot-note,[3] and we have rear-

[1] Coulson, On the Bladder, etc., p. 402.

[2] Thompson, On Practical Lithotomy and Lithotrity, p. 269.

[3] Table of prevalence of Stone in 1827 cases of Lateral Lithotomy at different ages:—

Age.	No. of cases.	Age.	No. of cases.
1	7	25	11
2	74	26	10
3	116	27	5
4	153	28	6
5	123	29	11
6	90	30	11
7	86	31	3
8	49	32	14
9	57	33	7
10	60	34	9
11	35	35	9
12	58	36	5
13	32	37	3
14	35	38	14
15	26	39	4
16	27	40	21
17	18	41	4
18	26	42	7
19	19	43	11
20	13	44	4
21	12	45	17
22	10	46	11
23	9	47	15
24	12	48	6

ranged the statistics derived from this table according to the different epochs or periods of life. Thus, under puberty, from 1 to 13 years of age, there are 940 cases, or 51.45 per cent. of the whole number; and this we may subdivide into two phases, viz., infancy and childhood, from 1 to 5 years, 473 cases, or 25.89 per cent.; and boyhood, from 6 to 13 years, 467 cases, or 25.56 per cent. At puberty, and during adolescence and approaching manhood, from 14 to 26 years, 228 cases, or 12.47 per cent. During the next ten succeeding years, from 27 to 36 years, 80 cases, or 4.37 per cent. At adult life, from 37 to 49, 127 cases, or 6.95 per cent. In advancing life, from 50 to 70, 414 cases, or 22.65 per cent.; and in old age, from 71 to 81, 38 cases, or 2.07 per cent.

Mr. Coulson aptly remarks, "that tables exhibiting the number of calculous persons at different ages of life do not show the liability of individuals to be attacked at these different ages." Here, as in many other statistical tables, an error has crept in from not taking care to distinguish between absolute and relative numbers of persons living at the several periods of life enumerated. Corrected in this manner, the tables would show that children and young persons are less liable to calculous disorders than has been commonly supposed, and that from twenty years and upwards the tendency goes on increasing in a very remarkable manner to the end of life; or, as Sir H. Thompson puts it, "that the proportion of elderly calculous patients to the existing population at their own ages is larger than the proportion of children afflicted is to the number of existing children."

The condition and habits of life have some effect as a cause. Thus sedentary habits impair the functions of the skin, and give increased work for the kidneys; so also luxurious feeding and use of malt-liquors and nitrogenized food in excess furnish a source from which concretions are derived; again, indigestion, mal-assimilation and fermentation, impairment of the vital powers and acidity generated in the stomach, are frequent causes.

Age.	No. of cases.	Age.	No. of cases.
49	10	67	14
50	23	68	17
51	15	69	8
52	11	70	16
53	17	71	8
54	25	72	5
55	23	73	4
56	26	74	2
57	25	75	9
58	16	76	4
59	22	77	0
60	33	78	1
61	17	79	0
62	22	80	4
63	22	81	1
64	16		
65	26		1827
66	20		

Respecting the exemption of sailors and soldiers from this disease, as alleged by Mr. Copland Hutchinson and others, we have not sufficient data to go upon.

Morbid states of the urinary passages may predispose to calculous formations, and more especially the presence of a foreign body, which is sure to cause a precipitation and deposit on its surface.

With regard to the influence of certain kinds of waters and spas, as a beverage, in inducing stone, it has been proved to be entirely imaginary; none of the forms of calculi correspond with the salts which exist in natural waters.

We shall now proceed to the description of the symptoms, effects, and treatment of urinary calculi as met with in the bladder, prostate, and urethra. Those of calculi in the kidney and ureter are described in the essay on DISEASES OF THE URINARY ORGANS, p. 749.

Stone in the bladder.—A vesical calculus may consist of every possible variety of the urinary concretions already described. Whatever may be the nature of the calculus, when once it exists in the bladder, it acts as a foreign body, and will give rise to sufficient evidence of its presence by inducing certain symptoms, so as to lead the surgeon to its detection. Of course all these symptoms are not uniformly met with; they may vary in degree and intensity, depending upon a variety of general and accidental circumstances, so that it will be prudent to have some standard as indicating the symptoms which are generally met with in patients suffering from a stone in the bladder. The symptoms are premonitory and actual. The premonitory symptoms can exist only in those cases where the stone is of renal origin, so that in many adults and old people the vesical troubles are preceded by paroxysms of nephritic colic; but in general these antecedent complaints, attending the formation of stone in the kidney and its passage along the ureter, are so severe, that directly the calculus has reached the bladder a more or less long interval of repose and quietude allays all further suspicion, and nothing more is thought of the complaint until the calculus has reached a sufficient size to be incapable of being expelled through the neck of the bladder.

The actual symptoms or signs of a stone in the bladder consist of two kinds; first, those evinced by the patient's sensations, etc., constituting the subjective or rational symptoms, which offer but presumptive evidence of calculus; and sec-

ondly, those signs detected through the aid of mechanical means, and termed physical signs, the only real method of determining and diagnosing the presence of a stone.

The subjective or rational symptoms consist of the following complaints: There is pain and sensibility, of a more or less acute character, referred to the region of the bladder or its neck; this may amount to a mere uneasiness or sensation of weight in the bladder, perineum, or hypogastrium, which may be so slight as to be unnoticed by the patient; or, on the other hand, the pain may be very severe and intense, occurring in paroxysms of great agony.[1] At first the pain is generally only intermittent, occurring during and after micturition, and more especially with the last drops of urine; and in children this is so frequent, and is attended with such irritation at the extremity of the penis, that they endeavor to allay it by drawing the penis and prepuce forwards; and this gives rise to an elongated condition of the prepuce, which is generally sodden with urine, as are also the fingers, causing them to emit a urinous smell. The pain is also aggravated in the acts of walking, riding, jumping, sudden exertions, jolting of the body, etc., and its intensity generally increases with the advance of the disease. Oftentimes the pain is reflected along certain nerves, inducing morbid sensations at their peripheral extremity; this pain is experienced in the extremity of the glans penis, in the scrotum and testicle, inducing contraction of the scrotum and swelling of the testicle; in the perineum, kidneys, down the thighs, etc.

John Hunter[2] quotes the remarkable case of the father of Lord Cavendish, who had pain in the left arm associated with calculus in the bladder, and this was the only indication of a want to make water. Some have had tormenting violent pains in the soles of the feet, with numbness and tingling.

The pain may last a considerable time, and then suddenly cease altogether, giving rise to the supposition of a cure.

Such was the case with the patient of M. Morand, mentioned in the Mémoires de l'Académie des Sciences, 1740, where a catheter detected a vesical calculus, but after that all symptoms gradually subsided, so that M. Morand was considered to be in error, and the patient bequeathed him his body to teach him a lesson; but on the post-mortem examination three calculi of the size of apricot-stones were found on one side of the bladder.

On the contrary, a stone may exist and grow to a considerable size without any evidence of pain, and then pain may all at once occur after some act of exertion.

Thus it happened in the case of a priest, who was in the act of taking some books off a shelf, when sudden symptoms occurred, after which the presence of a large stone was detected; here, in all probability, the calculus had been lodged and then suddenly ejected from its hiding-place.

Pain may be altogether absent; and such is the case when there is paralysis of the bladder, since then there is no desire to urinate, nor any efforts to expel the urine. After all, pain is no positive sign, for it may occur in other diseases; hence it merely directs the attention of the patient and surgeon.

In gouty patients a calculus in the bladder is attended with much pain and irritability, which is sometimes so severe that relief is anxiously implored.

Associated with pain is an alteration in the act of micturition: ordinarily there is a frequent desire, from irritation of the neck of the bladder, and there are futile attempts to evacuate the last drop; again, during the flow of urine there may be one or more sudden stoppages, but for a moment only, the stream reappearing in the ordinary manner. At times there is experienced considerable difficulty in urinating, and in some rare instances this has amounted to retention. In cases where the stone has attained a very large size, filling up and occupying the whole cavity of the bladder, incontinence of urine takes place, so that the urine flows in drops, the bladder having no room for receiving the fluid. All these varieties are not peculiar or essential to the presence of stone, for they are met with in other diseases of the bladder and urethra.

The character of the urine is of little assistance in the diagnosis, for urinary deposits may exist without calculus, and calculus may be present without any deposit whatever. The urine may remain perfectly clear and natural for a long period; it may also contain deposits, which may assist in ascertaining the nature of the calculus; but it may become at any moment turbid and mixed with mucus, which will be deposited in the shape of a tenacious matter remaining at the bottom and sides of the utensil, as seen in catarrh of the bladder. This secretion may become retained in the bladder, and may undergo decomposition giving rise to a fetid dirty-gray discharge; or it may even assume a puriform char-

[1] The pain was so severe, continuous, and intense, that a blacksmith at Amsterdam, and a cooper at Königsberg, performed self-lithotomy.

[2] Hunter's Works, edited by Palmer, vol. i., p. 321.

acter; or it may subside and entirely disappear for a short time. Albuminous urine is now and then met with, and may be due either to the presence of pus or blood in the urine, or it may be owing to diseased kidneys. Some practical deductions might be derived by investigating the relative importance of the different states and quantities of albumen in the urine in cases of stone; but hitherto this has not been done. Lithotomy has been successfully performed on many occasions in cases in which there has been a good quantity of albumen, even without pus or blood.

Hematuria is not always present: it generally takes place on expelling the last drop of urine, and occurs from the violent contraction of the bladder upon the stone; it may also result from sudden exertions—the jolting in a cart or carriage, the act of jumping, etc.; but by rest and the recumbent position it will speedily disappear.

Sometimes an erection of the penis is an attendant symptom, and in adults now and then involuntary emissions of semen occur.

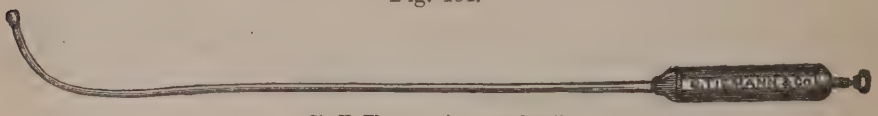
In some patients, especially adults, there is tenesmus and a sense of bearing down of the rectum, with frequent and fruitless attempts to pass a stool; in others, especially children, there is frequent defecation, and often feces are passed at every act of micturition; prolapsus of the rectum occurs very frequently in children, and sometimes in old men.

The physical signs of a stone in the bladder are to be derived from artificial or mechanical aid from without, giving to the senses of touch and hearing on the part of the surgeon distinct evidence of its presence. The means of attaining this is by the exploration of the bladder with a solid metallic instrument, which on coming in contact with the stone, enables one to feel the foreign body, and on striking it produces a ringing noise or sound; hence the term "sounding" given to the operation, and "sound" given to the instrument used.

The sound is somewhat similar to a catheter both in size and form, but is made of solid steel, which is well polished on its exterior, its length and size varying according to the age of the patient undergoing examination. The handle of this instrument is expanded and flattened, and also polished, in order to give a larger extent of surface for the fingers and thumb of the operator to receive tactile vibrations. The curve of a sound is generally that of the ordinary catheter; some prefer it shorter, curving at an angle of 45°, and others almost straight, except at its lower extremity, where it is bent or curved, and made somewhat bulbous (see p. 777). The reason why catheters are not ordinarily used is, that they are bad conductors of sound, and the presence of the stylet in the instrument may give rise to a rattling noise, a source of fallacy. A sound with a large curve may glide over a calculus, when lodged in a depression behind the prostate: hence in such cases, one with a short beak and at right angles should be employed.

[The Thompson searcher (fig. 464) is undoubtedly a better instrument than any steel sound, and it is doubtful if any of its numerous imitations possess any advantage over it. The light round corrugated handle allows the short beak to be rotated gently and evenly over a longer or shorter portion of a circle, and the finger may appreciate the slightest grit encountered during any part of the movement. There is no jar to the motion, a feature of great value in appreciating the existence of small stones. Moreover the instrument is a catheter, and the bladder may be examined by its aid at different degrees of distension without removing the instrument.]

Fig. 464.



Sir H. Thompson's "searcher."

The position of the patient in sounding should be the recumbent one; but in obscure cases it is necessary to vary this, and even to explore in the standing posture. The rectum should be empty, and the bladder moderately distended with urine. M. Civiale generally injected water previous to sounding.

The sound should be introduced carefully and slowly, and allowed to glide along the canal by its own weight; no force whatever is required, and in general no pain need be given. Having passed into the bladder, the point of the instrument is to be made to move gently from before backward, then from side to side, and is afterwards rotated slightly on either side, assisted at the same time by a partial withdrawal and reintroduction of the point of the instrument. The opera-

tion may be facilitated in obscure cases by the introduction of the finger into the rectum, or by making pressure with the hand above the pubes. In consequence of there being generally some fulness about the rectum, the stone is found sometimes lodged on the right side; large calculi are generally near the neck of the bladder, small and medium-sized calculi lie at the base, to the right or left side.

Sounding not only enables the surgeon to detect the presence of calculi, but it assists him in ascertaining their size, situation, number, and sometimes density. The size is determined by first traversing the surface of the stone with the convex part of the sound from side to side, and then carrying the point from before backward. The presence of more than one stone may be sometimes detected by careful exploration, although this may prove deceptive where a stone is very irregular. The situation of a stone may likewise be made out, as to its being loose and free, or fixed and encysted; whether it be on the right or the left side, at the base or in the walls, or in the upper part of the bladder.

The noise emitted on the striking of a stone with the sound has led to opinions that the size and density of the calculus may be thus detected; for some writers affirm that small and very movable calculi give but a feeble sound; smooth and dense calculi, as lithic acid and oxalate of lime, have a clear, ringing, sonorous character; the light, friable, and irregular ones, as the phosphates, emit a dull and scarcely appreciable sound. The smooth surface of a lithic-acid stone, and the rough irregular exterior of the oxalate of lime, may in most instances be detected by the instrument.

Difficulties and sources of fallacy in sounding are not at all unfrequent. Thus, a stone may be detected at one time, and not at another, owing either to its smallness or to its being temporarily caught up in the folds of the bladder; in fact, small stones easily escape detection, and readily recede before the sound when the bladder is moderately full of urine; hence in such instances the change from the recumbent to the erect posture may allow the stone to fall on the sound; or again, the evacuation of the water in the bladder by means of a catheter may cause the stone to be felt.

Sir A. Cooper (Lectures on Surgery, vol. i., p. 348) says: "I have myself sounded and not detected a stone at one time, which I have afterwards felt. I have sounded and not discovered a stone which another surgeon has afterwards perceived. I cut a patient and extracted thirty-seven stones from his bladder, who had been sounded and declared not to have a stone."

S. Cooper (First Lines of Surgery, p. 688) remarks: "In sounding, how possible it is to mistake a thickened indurated bladder for a stone in that organ may well be conceived, when it is considered that Cheselden, with all his judgment and experience, actually cut no less than three patients, none of whom had any stone in the bladder at the time of the operation."

The principal difficulties and sources of fallacy are, however, a large and deformed bladder—a contracted bladder, unable to contain urine—a sacculated or encysted bladder—an irregular hour-glass contraction of the bladder—calcareous matter adhering to the walls of the bladder—an enlargement and roughening of the prostate gland—calculi in the prostate and urethra, and tumors at the neck of the bladder. Again, the calculus may be coated with blood or mucus. Some of these difficulties may be overcome by varying the position of the patient, by the use of sounds of different sizes and curves, and by moderately distending the bladder with two or three ounces of tepid water. The presence of a stricture in the urethra may offer difficulties, which must be overcome in the ordinary manner by dilatation.

[In cases of doubt, the large catheter and washing-bottle, as described in the section on rapid lithotrity, may be used as an extra means of sounding to detect the presence of a movable calculus.]

Sounding may produce cystitis and peritonitis; hence caution and gentleness are necessary in its use.

In some instances exploration with a lithotrite has cleared up a difficulty; but care must be taken not to mistake the opening and closing of the blades for the sensation of a stone. When using the lithotrite and engaging the stone, we can take a very fair measurement of the axis and the size of a stone, a point which will be referred to in the essay on LITHOTRITY.

Sir Henry Thompson has suggested and employed a modification of the lithotrite,[1] which may act as a sound, catheter, and measurer.

Exploration of the base of the bladder by the introduction of the finger into the rectum may lift the calculus out of the hollow, so that the sound may easily strike it; and, in fact, in children and in some adults the stone may be felt through the rectum. This examination likewise enables us to detect the presence of polypi,

[1] Weiss's catheter-scoop with stopcock. See Thompson, On Pract. Lithot., p. 219. This instrument in its original form was constructed for injecting and removing the debris of calculi from the bladder; by the addition of the stopcock, it is also useful for measuring the size of the stone and for sounding. See the essay on LITHOTRITY.

tumors, scybala in the rectum, and such other complaints as may give rise to the symptoms of stone.

In the female, vaginal examination is most important, and on making pressure above the pubes at the same time, the stone may in most instances be felt. Uterine disease, a source of fallacy as simulating stone, may thus be ascertained.

The employment of the stethoscope in the pubic, sacral, and perineal regions is not attended with much satisfactory result. Succussion likewise is of little service; and where there are many stones the patients in their movements readily perform the operation themselves, and acquaint their surgeon of the matter.

The prognosis of this complaint must always be of a serious character; there are no means whereby we can arrest the disease, unless by removal, through operative measures, of the offending foreign body; otherwise death is the sure consequence at a more or less remote period. Spontaneous expulsion of the stone through the urethra now and then takes place, when small, and in some rare instances nature has effected a cure by causing the stone to be extruded by ulceration through the rectum, vagina, or perineum. These, however, are but exceptional cases. The surgeon also has to bear in mind that, although a stone has been successfully removed, yet in isolated cases a second or even a third stone may become developed.

The progress and termination of the disease in patients affected with calculi in the bladder are exceedingly distressing and productive of much anxiety. These, of course, will vary according to the condition of the calculus, the constitution of the patient, and the age and temperament of the individual. In some rare instances there are no symptoms whatever, so that it is only after the post-mortem examination that the existence of a stone has been ascertained. In others, again, the symptoms may be sufficiently well marked yet not severe, and may be prolonged over a number of years without exciting any great distress or anxiety. But in ordinary cases there is always an increase of the symptoms, more or less slow, but constant, leading to great anxiety and inconvenience; the patient becomes thin and worn out, the health impaired, the stomach deranged, and the secretions vitiated. The skin becomes dry and the extremities cold; the micturition frequent and distressing; and soon atony and atrophy of the bladder takes place, so that there is inability to void the urine except in the reclining posture: the urine, in consequence, becomes in part retained and undergoes decomposition, assuming an ammoniacal and offensive character. Much suffering now ensues; exhaustion, loss of sleep, disturbance of digestion, and low fever set in; next, colliquative diarrhœa, and speedy death.

Such are the ordinary results; but other changes may take place and modify the progress of the case; thus, acute cystitis may attack the patient. as evinced by the intensity of the pain, frequent micturition, and muco-purulent condition of the urine; ulceration of the mucous membrane of the bladder may ensue; acute or chronic inflammation of the kidney, or even acute suppuration of the kidney, may set in, and carry the patient suddenly off by uræmia or pyæmia.

There may be also hyperæmia, hypertrophy of the coats of the bladder, irritable bladder, catarrh of the bladder, dysuria, hematuria, ulceration and sloughing, with perforation allowing the escape of the calculus into the peritoneum, rectum, vagina, or perineum; or pelvic cellulitis may be induced, followed by diffused suppuration.

Calculi may become encysted either by means of the formation of a hernial protrusion of the mucous membrane through the muscular coats of the bladder, or by the presence of a parietal abscess of the bladder opening internally and receiving the stone in its sac. Sometimes a large and heavy stone becomes lodged behind the neck of the bladder, and here forming a diverticulum or bed for itself, becomes more or less fixed.

The post-mortem appearances of those who have died with a calculus in the bladder will of course vary, according to the mode of death and the complications which have previously existed. Ordinarily they will consist of chronic cystitis and chronic inflammation of the ureters and pelvis of the kidney, with slow changes in the glandular structure of the organ.

The *treatment* will consist in palliating and relieving the immediate distress, and then resorting to such means as may produce a permanent cure. When a stone has arrived in the bladder we should acquaint the patient with the fact.

The palliative measures will comprise such treatment as may improve the general health and the secretions and excretions, as well as relieve any complications which may exist, such as catarrh, cystitis, ischuria, enuresis, nephritis, prostatitis, etc., by the methods usually adopted in such diseases. Great attention must be paid to the diathesis of the patient suffering from calculus, as evinced by the nature of the sediment passed, whether it be lithic acid, phosphatic, or oxalate, and this must be treated as laid down in the early part of this essay—by careful attention to diet and regimen, due regard to the action of

the skin and bowels, and the use of sedatives and anodynes to relieve pain; not forgetting to correct the nature of the morbid urine by appropriate medicines, such as mucilaginous drinks, diluents, etc. Oftentimes the paroxysms of pain are relieved by the recumbent position, with the thighs and buttocks raised, and the body bent forwards to relax the abdominal muscles. A decoction of the triticum repens is highly recommended by Sir H. Thompson as giving great relief.

The curative means will comprise the removal of the stone from the bladder; and three methods have been advised and adopted: first, the attempted dissolution of the stone by chemical and other agents, such as the far-famed "lithontriptics," and the solution by electrolysis; secondly, the removal of the stone by mechanical means without a cutting operation, such as dilatation of the urethra, and lithotrity; and thirdly, the extraction of the calculus by operative measures, commonly known by the term lithotomy.

The cure by lithontriptics has engaged the attention of surgeons, physicians, physiologists, and chemists, and has been had recourse to by quacks and empirics of all descriptions. Dr. Prout has fully pointed out the importance of the administration of increased quantities of fluid in certain calculous and other affections, showing that many comparatively insoluble substances are slowly dissolved away by the frequent renewals of the fluid in contact with them.

Lithontriptics have been employed internally, through the general system, by the administration of certain medicines and waters, as well as locally by the injection of solvents into the bladder and the use of electricity.

The constitutional remedies generally made use of consist in the prolonged use of alkalies, but often to the detriment of the general health; these are inadmissible in oxalate-of-lime calculi, as the latter resist their influence; so also in phosphatic calculi they are prejudicial, inasmuch as acids are of more beneficial effect in arresting the growth of such stones; but in the lithic acid variety much relief has accrued, and in some instances the growth of the calculus has been decidedly cut short by the use of such alkalies. The alkaline waters are supposed by some to act not merely by a process of solution, but by causing a kind of disintegration of the component parts of a calculus. Liquor potassæ and the carbonates and bicarbonates of soda and potash are the usual medicines employed. The Vichy waters have become renowned as a favorite and useful remedy in calculous disorders; and in some instances persons having undeniable stone, as ascertained by sounding, have had their symptoms relieved, and even removed, whilst partaking of the waters. The Académie des Sciences, in reporting upon the use of alkalies in cases of calculi, thus sums up this subject: "Although we admit that alkaline bicarbonates are not without influence on calculi, yet these present sufficiently great difficulties in their mode of application to cause them to be regarded with caution."

Some prefer the use of the borate of soda, as being more energetic; and again, others have suggested the use of gastric juice, malic acid, and the nitro-saccharate of lead as having dissolvent powers. The celebrated nostrum of Mrs. Stevens was made of calcined eggshells and soap.

However, up to the present time no satisfactory remedy has been discovered. The local use of lithontriptics, viz., the injection of solvents into the bladder, has also been sedulously tried, and many experiments have been performed on calculi to ascertain their solvents, which have then been employed by means of injection into the bladder through a catheter. Unfortunately the solution, if strong enough to be of any use, endangers the coats of the bladder, and when diluted its action is uncertain in the extreme. Diluted alkaline solutions are recommended for uric acid calculi; diluted acids, such as the hydrochloric acid, for phosphatic;[1] and dilute nitric acid for oxalate of lime. Salts of lead, carbonate of lithia, nitro-saccharate of lead have been suggested; the latter as being less injurious to the bladder. The free use of water, by introducing it through a double catheter and keeping up a continued stream for half an hour every two or three days, has been employed: Dr. Willis has recommended that the fluid should be placed in a reservoir at a sufficient height above the patient, and connected with the catheter by a tube provided with a stopcock, by which means the flow of the solvent may be carefully regulated.

M. Pelouze, in the 14th vol. of the Comptes Rendus of the Académie des Sciences, thus sums up the conclusions that have been arrived at: 1st, the effects

[1] Sir B Brodie has shown that phosphatic calculi might be greatly reduced in size, or entirely dissolved, by injecting a weak solution of nitric acid, two to two and a half minims of strong acid to the ounce of distilled water.

Dr. Hoskins employed a weak solution of acetate of lead (gr. j ad ℥i) with a mere trace of free acid. With a phosphatic stone double decomposition occurs; phosphate of lead, in the form of a fine granular precipitate, and an acetate of lime and magnesia are formed.

of different agents upon urinary calculi proceed very slowly, and are chiefly evinced upon the animal matter which enters into their composition; 2dly, drinks and baths never effect a cure; 3dly, the results of injection are problematical, and the danger of inflammation is not counterbalanced, as in lithotrity, by a rapid destruction of the calculus; 4thly, although the combination of lithotrity with injections increases the probability of success, yet it is most desirable to proceed with lithotrity.

The dissolution of calculi by electricity (electrolysis) has had its advocates. Sir W. B. O'Shaughnessy has recommended the transmission of an electric current by means of a properly constructed instrument; but it is difficult in its application, and is attended with risks to the bladder. The latest and most successful efforts are those of Dr. Bence Jones, who employed a solution of nitrate of potash, and decomposed this by the aid of a powerful galvanic battery. The nitric acid set free at the positive electrode would decompose the uric acid exposed to its influence, and the potassa evolved at the negative electrode would dissolve it; so that a uric acid calculus placed between them would be disintegrated at both points. The battery employed was from five to twenty pairs of Grove's plates. From two to nine grains of uric acid calculus were dissolved per hour at the temperature of the body; of oxalate of lime, half a grain to two grains per hour only were dissolved—the action was four times as slow as upon uric acid calculi; of oxalate of lime and uric acid in alternating layers, four and a half to five grains were dissolved per hour; of phosphatic calculi, upwards of twenty-five grains were dissolved per hour. Dr. L. Melicher (Oester. Med. Jahrbuch, 1848, vol. i., p. 154) tried to dissolve a calculus by the aid of electricity; it is stated that two experiments on the living body were successful.

Gruithuisen, in 1823, suggested the dissolution of stone by means of the galvanic pile, but no experiment has been made on man.

[Modern progress in the removal of vesical calculi has not been in the direction of lithontriptics, or of solvent injections—and electrolysis has few advocates in any of its forms.

Lithontriptics have proved more and more unreliable, as exact observation has been brought to bear upon an unbiased study of their results.

Injections, and the application of electricity, are so slow in their action and necessitate such an amount of instrumentation of the bladder and urethra for so long a period of time, in order to be of any material service, that the risk to the patient in their employment is greater than that attaching to improved modern lithotrity.

Practically, therefore, when a stone exists in the bladder too large to be expelled through the natural channel by aid of dilatation of the latter, and the use of diluent diuretics and mineral waters, one of three courses must be elected by the surgeon.

(1.) Modern improved lithotrity.
(2.) Lithotomy.
(3.) Non-interference, soothing the symptoms by palliative treatment—when serious organic disease or the size of the stone in an aged person contraindicates any serious operation.]

The removal of a calculus by mechanical means without the use of the knife is confined to a certain class of cases. In the early stage, when the calculus is small, we may assist nature in its expulsion from the bladder by administering alkaline purges, by dilating the urethra with a large bougie, and giving diuretics; the bladder should be allowed to retain as much urine as possible, and then a free and copious evacuation may carry the stone along with it. Should the calculus become lodged in the urethra, it may be extracted by means of forceps, such as described and used by Hunter, Civiale, Sir A. Cooper, and others.

In females this plan is very practicable, and we shall refer further on to it.

The removal of calculi by lithotrity, together with the arguments in favor of this proceeding, will be the subject of special consideration in the next essay.

We now come to the extraction of a calculus by means of an artificial external opening, a necessary operation when lithotrity is deemed unadvisable. This operation is termed lithotomy. There are three situations in which it may be performed, viz., in the perineum, in the hypogastric or supra-pubic region, and through the rectum; each of which will have to be considered.

1. *Perineal lithotomy.*—There are several methods by which we may remove a stone from the bladder through the perineum; but we shall at present only refer to the ordinary lateral operation, leaving the other modes to be described as attempted improvements thereon. The necessary requirements for the operation consist in having a firm, solid table of sufficient height to bring the perineum in a line with the operator's face, he being seated upon a stool sufficiently low to suit the height of the table; the table should be narrow, so as to enable the assistants to have more complete command of the

patient. Two rollers or bandages should be at hand for securing the proper position of the extremities. [Fig. 465 represents

Fig. 465.

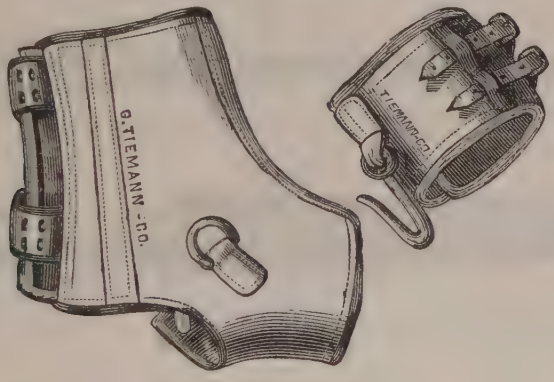
Position of patient, and line of incision in lateral lithotomy. (Erichsen.)

the patient in the lithotomy position, tied with bandages, the hands and feet being bound together. The position of the external incision in lateral lithotomy is also represented, and the hand of the chief assistant grasping the staff in position.

The old fashioned bandage may be very favorably replaced by Pritchard's anklets and wristlets (fig. 466), made of strong leather and properly padded.]

The instruments employed are the following: a staff, which is to act as a guide or conductor for the knife to enter the bladder; it varies in length and size, according to the age of the patient, and consists of a grooved steel sound, curved like the ordinary catheter, the groove being deeply made betwixt the lateral and convex aspects, and terminating within a quarter of an inch of the extremity, so as to prevent any further onward movement of the knife. [Fig. 467 represents an excellent model for a staff. The curve is longer than that of an ordinary sound and has a backward projection recalling the Bénique curve. This extra curve makes the instrument when in place bulge out more in the perineum, and indicates the position of the urethra very clearly—especially in fat persons. The cross-markings on the handle make it easier for the assistant to hold the staff immovably in position.

Fig. 466.

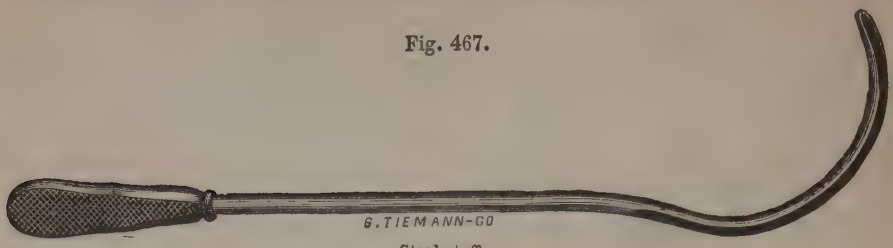


Pritchard's anklets and wristlets.

Fig. 468 represents the modified rectangular staff which is preferred by a few operators.] The staff has been modified in shape, with the hope of facilitating the operation; thus Aston Key suggested and used a straight staff, which has been and is still employed by all the surgeons of Guy's Hospital; it is nothing more than a very long director, slightly bent at its extremity, having the groove placed in the median line. The knife also varies in shape and size, according to the operator's fancy; some use a common scalpel for the first part of the operation, and then it is exchanged for a button-pointed bistoury, to complete the section. Liston performed the whole operation with a common sharp-pointed, scalpel-shaped bistoury; and Key did the same, but his knife was slightly convex on the back near the point; it was longer in the blade than an ordinary scalpel, but about the same breadth. The knife used for children is to be of smaller and narrower dimensions, but not to any great extent. A probe-pointed bistoury is likewise necessary, should any subsequent enlargement of the section be requisite. [Nothing in the way of a probe-pointed bistoury is better than the American modification of Blizard's knife (fig. 469). This knife practically replaces the cutting

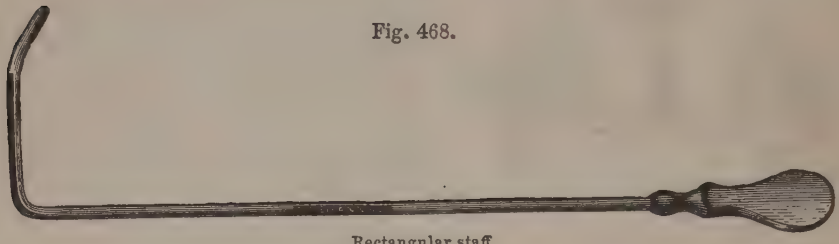
gorget; and the blunt gorget, although found among the lithotomy instruments of all older operators, is very seldom employed, and may be discarded—its function was mainly that of a speculum in cases of very deep perineum in fat persons,

Fig. 467.



Steel staff.

Fig. 468.

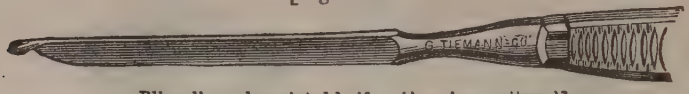


Rectangular staff.

and somewhat of a director when the prostate was very large and deeply seated. Fig. 470 represents the blunt gorget.]

Again, some experienced lithotomists, and especially those of early days, prefer completing the operation with an instru-

[Fig. 469.

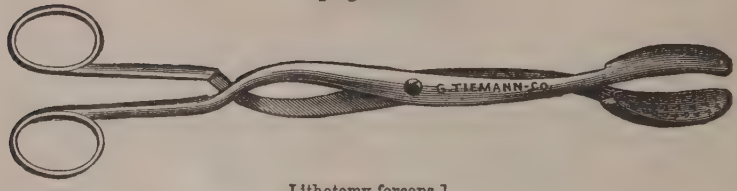


Blizard's probe-pointed knife. (American pattern.)]

[Fig. 470.

Blunt gorget.]

[Fig. 471.



Lithotomy forceps.]

ment called a gorget; this is a broad wedge-shaped instrument, either *blunted* at the point and sides, or sharp and *cutting;* although in occasional use, it is seldom had recourse to nowadays—excepting, it may be, the blunt one, in cases of very deep perineum and of enlarged prostate—the surgeon preferring to make his requisite incisions to certain, instead of uncertain measurements. The forceps are of different sizes and shapes, to suit every variety of difficulty; ordinarily they are straight, and the blades so constructed as to allow of an oval space between them when closed, in order that the calculus, when seized, may not be crushed in the efforts at extraction; some are curved, so as to seize the stone should it be engaged

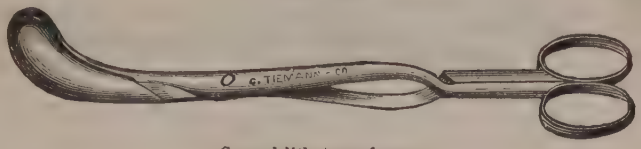
in the upper part of the bladder, or fallen into a pouch behind an enlarged prostate, or encysted elsewhere.

[Figures 471 and 472 represent the two types of forceps. It is desirable to have two sizes of the straight variety; one large forceps of the curved pattern is enough, since this forceps is designed chiefly for old men—to lift a stone out of the bas-fond, behind the prostate.

The crossing of the handles gives this variety of forceps a much greater grasping power with less stretching of the wound than can be accomplished by other means.

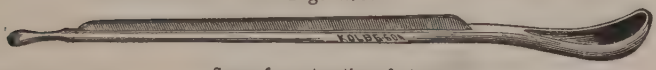
Fig. 473 represents one of the most

Fig. 472.



Curved lithotomy forceps.

Fig. 473.



Scoop for extraction of stone.

useful scoops; it also acts as a conductor for the forceps in case of deep perineum.]

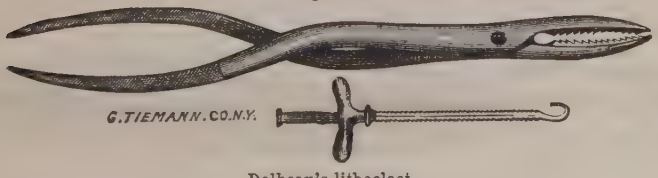
In children, a pair of common dressing forceps, somewhat lengthened in the handle, will answer all purposes. A scoop is likewise necessary, and proves at times an invaluable instrument; it is chiefly employed in levering out fragments when a stone, from its friability, has crumbled to pieces; but it is also of great assistance when the stone is small and eludes the forceps, and on its introduction, together with the aid of the finger, the stone may be readily drawn out by a kind of leverage of the scoop and finger in opposite directions. In Russia a kind of spoon is used in almost all cases, and with great success and ease. A syringe and tube should likewise be within reach, in case it is necessary to wash out the bladder. A female staff and sound is sometimes needed; and a strong lithotrite or crushing forceps, for facilitating the extraction of a large stone.

[Gouley's lithoclast (fig. 474) is a convenient instrument, when the stone is

Fig. 474.

Gouley's double-lever lithoclast.

Fig. 475.



Dolbeau's lithoclast.

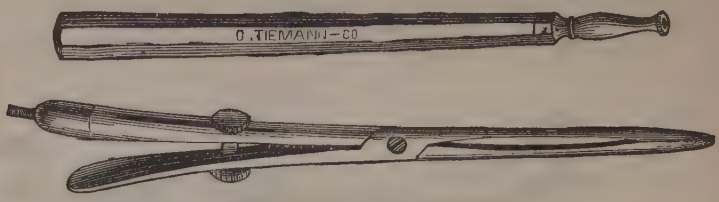
large and soft, and Dolbeau's lithoclast (fig. 475) or Maisonneuve's stone crusher when it is large and hard (fig. 476). Other useful instruments to have on hand are Gross's artery compressor—in case of a bleeding point in the wound, too deep to tie, the end of the forceps being unscrewed from the handle and left *in situ* (fig. 477)—the débris tube with obturator to wash out dust when the stone is

broken during extraction (fig. 478), or the débris syringe (fig. 479), and a Guyon's tampon (fig. 480), a rubber bag to inflate around a catheter to arrest hemorrhage, or the old-fashioned shirted canula (fig. 481), which may be extemporized by a catheter

Fig. 476.

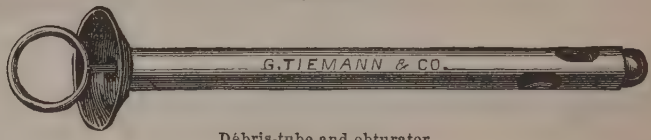
Maisonneuve's stone crusher.

Fig. 477.



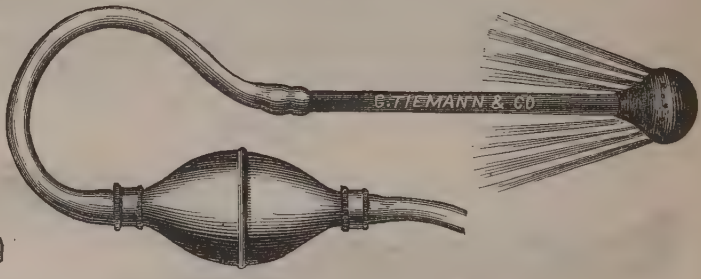
Gross's artery compressor.

Fig. 478.



Débris-tube and obturator.

Fig. 479.

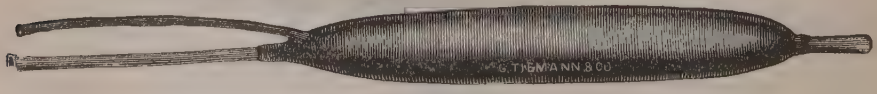


Van Buren's débris-syringe.

and a piece of muslin (as in the figure), the muslin being stuffed with sponge or lint after the instrument has been inserted into the wound.]

In all cases having to undergo lithotomy, certain preliminary precautions have to be attended to, which may materially influence a successful issue. Key paid

Fig. 480.



Guyon's tampon.

great attention to this point, but Liston was not an advocate of too much preparation. The secretions and excretions, if at fault, should be corrected by appropriate remedies, and the nervous system quieted by anodynes; the urine, especially, should be rendered as healthy as possible, by acids or alkalies, as suits the individual case; sometimes, however, the suffering is so intense that immediate operation is indispensable. It is highly necessary to have an empty rectum; hence it is usual

Fig. 481.

Shirted canula.

to prescribe a mild purgative powder overnight, to be followed in the morning by an enema of castor-oil, taking care that a free evacuation takes place before operating. Some, as Coulson, prefer giving two enemata, the one to be administered three hours previous to the operation, and to consist of gruel, olive-oil, and salt; the second to be employed about one hour before the time, and to be composed of gruel, with the addition of twenty drops of tincture of opium. The perineum should be shaved if necessary.

The patient is placed upon the table, and chloroform [or ether] administered; notwithstanding its depreciation by some lithotomists, it materially facilitates the operation, and its effects have not been found in any way to interfere with a successful result.

Four assistants are required besides the administrator of chloroform, viz., one for each side, so as to hold the patient in position, a third to take charge of the staff, and a fourth to assist the operator, in handing the instruments, etc. When under the influence of chloroform, the patient is placed and fixed in the proper position so as to expose the perineum to its fullest extent, and in an entirely perpendicular direction. This is done by flexing the knee and hip-joints to such a degree that the patient's hands may be made to grasp the feet, when they are to be firmly secured by a well-adapted figure-of-8 bandage over hand, foot, and ankle; the knees are now widely separated, and each held by an assistant, encircling it with his proximate forearm and hand, and embracing and drawing the foot outwards with the other hand, and thus steadily maintaining the proper position until the completion of the operation. The shoulders and chest have to be raised to the requisite extent, and the patient then to be slided along to the edge of the table. Some use a neck ligature, which passes under both knees and around the neck, but it is at present generally dispensed with. Some surgeons do not tie up their patients, but use a kind of table with upright props on either side of the lower end, which are connected by a transverse bar: over this the patient's legs are placed, and there maintained in position. This table is so made as to suit all cases. Lately, padded leather bracelets, fixed by hooks to firm leather anklets, have been recommended and used. Children need not be tied up.

The patient being now in an accurate position, the surgeon introduces the staff into the bladder: this is to be done in the same way as an ordinary catheter, whatever shape the instrument may be. Some introduce it before the patient is tied up, as being more easy; but this plan has the drawback of causing the escape of urine during the subsequent process. Again, the orifice of the urethra may be narrow, which is to be rectified by enlargement with a bistoury. The staff should always be of as large a size as the urethra will permit, but not of too great a size, as it may tear the urethra. It should always be made to strike the stone, and left in contact with it. When stricture exists with stone, the former should be rigorously attended to before proceeding to operate. Care must be taken not to mistake the promontory of the sacrum for a stone in sounding. We shall now give an account of the ordinary lateral operation with the curved staff.

A curved staff, of sufficient calibre and grooved deeply between the lateral and convex surfaces, is introduced into the bladder, and the end made to rest upon the stone; this is intrusted to an assistant to maintain *in sitû* as delivered to him by the surgeon from first to last, with instructions not to depress the handle as the knife enters the bladder. Some surgeons prefer making the convexity of the staff to bulge in the perineum, so as to be more readily felt; others, as Liston, require it to be hooked against the symphysis, as a more steady security. The surgeon's left hand is thus left at liberty throughout the whole operation to guide the knife, guard important parts, etc. etc.

The operator proceeds with the first step of the operation, viz., to lay bare the groove of the staff by an oblique perineal incision; and this of course requires careful previous anatomical knowledge of the

neighboring parts, and the course the knife ought to take to escape important structures, such as the bulb and its artery above, the rectum in the median line, and the internal pudic vessels to the outside. There is the raphé in the median line, succeeded by the anal aperture, and on either side the ramus and tuberosity of the ischium, leaving an intermediate triangular space almost free from danger. The point of commencement is a little to the left of the median line, at a variable distance in front of the anus, and the incision is to be carried obliquely downwards and outwards, midway between the anus and tuber ischii, to the extent of 3 to 3½ inches. Some discrepancy exists as to the exact spot of commencing: thus Cheselden, Keith, and Crichton, all of whom have been remarkably successful, recommend 1 inch in front of the anus; Brodie, Stanley, and Skey, about 1¼ inch in front; Fergusson and others 1¾ inch. All these measurements refer to the adult perineum. The best practical direction is to commence about midway between the anus and scrotum.

The knife is plunged freely into the perineum and carried downwards and outwards, dividing the skin and superficial fascia, as also the transverse perineal muscle and its artery, and some fibres of the levator ani muscle, laying open the perineal triangle and ischio-rectal space. The forefinger of the left hand is then introduced into the wound through the loose cellular tissue to gain the groove of the staff behind the bulb, and just anterior to the resisting deep fascia, when the point of the knife, being slipped along the nail of the finger, and thus guided by it, is made to enter the groove at this spot, viz., the membranous portion of the urethra. The left forefinger can also be used to depress and protect the rectum.

The second step is the deeper section, which is effected by carrying the knife along the groove of the staff through the deep fascia, the membranous portion of the urethra, with its muscles, the left lobe of the prostate gland, and a small portion of the neck of the bladder. This is done by maintaining the left forefinger still in the groove, and making perfectly sure that the knife is securely within it; then, by a slight movement of the right hand, the knife is lateralized so as to correspond to the direction of the external wound, and steadily pushed onwards, until a feeling of loss of resistance or a gush of urine takes place. This is one of the most important parts of the operation, namely, the mode and extent of dividing the prostate gland; and no surgeon should undertake the performance of lateral lithotomy in the adult without a due knowledge of the size, shape, and condition of the organ, and its relation with such vital surrounding structures as the recto-vesical fascia and peritoneum, the great object being to have a sufficient opening to allow of the passage of the finger, without bruising or tearing the parts. Some surgeons recommend small incisions and subsequent dilatation; others make a free section corresponding to the size of the stone, without regard of exceeding the limits of the gland. Liston is very minute and particular on this point.[1] [It is extremely probable that the capsule of the prostate is, as a rule, cut through at its posterior part in the sulcus between the rounded back part of the prostate and the muscular fibres converging to form the neck of the bladder just inside of the seminal vesicle. Some experiments instituted by Dr. L. A. Stimson and myself upon the cadaver proved this to my satisfaction. Yet this incision does not influence the success of the operation, and infiltration of urine into the pelvic cellular tissue does not take place on this account. In children, when large stones are cut for, the capsule of the rudimentary prostate is

1 "This internal incision must be very limited indeed; it should certainly not extend beyond six or seven lines from the urethra outwards and downwards; for the less that is cut the greater will be the patient's safety." At p. 510 (op. cit.) he introduces a sketch "to show what is indispensable to cut—it is a section of the dense, unyielding fibrous tissue at the base and in front of the gland into which the muscular fibres are inserted; it appears as a white triangular band, effectually preventing dilatation or enlargement of the orifice of the bladder beyond a certain and very limited extent, without laceration, dreadful suffering, and imminent danger. The incision required to divide this need not pass very far from the groove of the staff; and if that is effected, the dilatation can be carried to any required extent. The object in following this method is to avoid all interference with the reflexion of the ilio-vesical fascia, from the sides of the pelvic cavity over the base of the gland and side of the bladder. If this natural boundary betwixt the external and internal cellular tissue is broken up, there is scarcely a possibility of preventing infiltration of urine, which must always certainly prove fatal. The prostate and other parts around the neck of the bladder are very elastic and yielding, so that, without much solution of their continuity and without the least laceration, the opening can be so dilated as to admit the forefinger readily; through the same wound the forceps can be introduced upon this as a guide; and they can also be removed, along with a stone of considerable dimensions, say from three to nearly five inches in circumference in one direction, and from four to six in the largest."

very freely divided, no attention being paid to it—and infiltration of urine does not follow. There is more danger in lateral lithotomy from too small a cut at the neck of the bladder than from too extensive an incision.]

The third step is the introduction of the forceps and the removal of the stone. Now, although the second proceeding is one of the utmost delicacy and moment, the present far excels it in difficulty of execution, and is often the cause of the delay and trouble witnessed in lithotomy. The knife having been withdrawn, the left forefinger is carried on along the staff into the bladder; and on feeling the stone, the sound may be removed; the surgeon now ascertains its position and size, and then proceeds with a suitable pair of forceps to seize and extract the calculus. The forceps are introduced shut, and guided by the finger into the bladder, the handles being gently raised so as to gain the fundus of the bladder, when the blades may be separated, one of which is to be made to slip under the calculus, and the instrument then closed upon the stone. The point is then gently raised, by depressing the handles, so as to bring it towards the external incision, when extraction is to be made in the direction of the axis of the pelvis slowly and deliberately; the instrument is moved forwards and backwards gently, so as to dilate the parts, and these are pushed back, as it were, upon the stone, by the finger of the left hand, whilst the extracting force is kept up.

The surgeon may in this stage meet with perplexities. He introduces his forceps through the section he has made and finds no evidence of stone, although the calculus was clearly discovered previous to the operation by its ringing sound and by the evidence of other surgeons. This casualty must be borne in mind and the sources of fallacy considered: viz., 1st, the stone may have been a small one and expelled with the first gush of urine on section of the prostate. [At this day it is not proper for a surgeon to cut a patient until he has caught the stone in a lithotrite and measured it—exceptions only covering encysted stones and stones too large to be caught. If this be done, lithotomy need never be performed for a small stone, since a little crushing with a lithotrite and simultaneous washing of the bladder as in Bigelow's operation (litholapaxy) relieves the patient with less risk than that offered by lithotomy, as proved by statistics. Hence no modern surgeon need ever cut a patient and find no stone, as has been done by some of the greatest surgical lights of former days. Modern improved methods of searching make it impossible for a properly educated surgeon to commit this error.] The stone may fall out on to the ground, or become driven into the anterior part of the urethra, or have escaped into the rectum, should the latter have been wounded; 2dly, the stone may be encysted, and hidden in one of the diverticula of the bladder, perhaps entering into the orifice of the ureter; 3dly, the presence of a tumor at the base of the bladder, behind which the stone has become lodged; 4thly, the section through the prostate not having been completed, so that the forceps, instead of entering the bladder, has passed between it and the rectum.

After the removal of the calculus, the finger must again be introduced into the bladder, so as to ascertain the existence or presence of any other stone; and if the perineum be very deep, a searcher or sound may be passed.

Lateral lithotomy with the straight staff was first introduced by Aston Key at Guy's Hospital, where it is still used by the surgeons. It has its advantages and disadvantages; but upon the whole the straight is as satisfactory an instrument for a guide into the bladder as the curved staff. Of course some little modification in the mode of conducting the operation is required, although the steps are almost precisely the same as in the foregoing operation, viz., to open the perineum and urethra, to open the bladder, and to extract the stone.

The operator with the straight staff must bear in mind, in the first place, that it is more liable to be tilted out of the bladder than the curved one; hence the surgeon is always very careful to ascertain that the end of the staff rests on the calculus previous to his commencing the incision. Again, it is also not so easily introduced along the urethra into the bladder when the patient is placed in the position for operation; but this difficulty is readily overcome by the practised operator. During the first step of the operation with a straight staff, there is generally a twofold or subdivided proceeding, viz., laying open the perineum first of all, and then laying open the urethra. This is necessary with the straight staff, as the membranous portion of the urethra is placed at a very great depth, and any attempt to enter the urethra early would involve the bulb and its artery. This is the chief objection to the use of this instrument. Thus, then, in the first incision the integuments and superficial fascia are cut through, and the knife made to traverse the transversus perinei muscle and fibres of the levator ani, giving a good external opening; the next point is to pass the forefinger of the left hand through the loose cellular tissue in the triangular space until it im-

pinges upon the staff beyond the bulb, necessitating a much longer track than with the curved staff. The bulb is now protected, and the knife made to enter the membranous portion of the urethra; this must be thoroughly and unquestionably exposed: a point on which the success of the operation entirely depends.

The surgeon, while maintaining the knife in the groove of the staff, withdraws the left forefinger, and now takes charge of the staff from the assistant with the left hand; then depressing the handle and bringing it parallel with the axis of the pelvis, thus presenting a direct passage to the bladder, he lateralizes both staff and knife simultaneously to the left side of the patient, so as to correspond to the external incision, and carries the knife onwards to the bladder, regulating the section of the prostate at the same time, or on its withdrawal. Key's knife has a double convex extremity; hence great caution is required to keep the point upwards in the groove of the staff at an angle of 45°: for if the staff and knife be held too parallel to each other the upper convex border of the latter will be tilted out of the groove just anterior to the prostate, and instead of entering the bladder, it will pass into the pelvic cavity. The third step consists in laying the knife aside, and transferring the staff to the right hand, so that the left forefinger may be introduced into this wound, and guided by the staff into the bladder, so as to feel the stone, and when satisfied of its presence, maintaining it there *in sitû*, while withdrawing the staff. The forceps is now introduced along the finger, and the operation of extraction proceeded with as already detailed.

After the removal of the stone, provided no casualties or difficulties have occurred, some experienced operators recommend the introduction of a gum-elastic tube through the wound into the bladder, where it is to be secured properly by tapes; this is left in, in children, for twenty-four hours; and in adults, for forty-eight hours. Liston says, "It is especially adapted for the aged;" and he attributes much of his success to its employment, "as it occasions no inconvenience, and affords great facility for arresting any oozing that may arise from the vessels." In general, however, it is dispensed with. [Growing experience condemns the old fashion of tying any instrument either in the urethra or in the bladder through the wound, except in case of considerable hemorrhage where a tampon is required.]

The patient is unbound, carried to bed, and laid on his back, with his body raised and his knees bent over a pillow, with the pelvis resting upon a draw-sheet; so that the latter may be drawn away at intervals, as the urine saturates the sheet.

Some surgeons, as Crichton, recommend immediate closure of the wound, in order to gain union by the first intention. Some cases have succeeded well, but others have been followed by severe inflammatory symptoms; hence, as a rule, it is not advisable or justifiable to adopt this measure.

Little or no medical treatment is required, except, perhaps, the exhibition of opium when there is great restlessness; where the bowels are not relieved within six days a castor-oil enema, carefully given, will be sufficient.

Before adverting to the several varieties of operative measures suggested in lieu of lateral lithotomy, for removing and remedying the defects and difficulties which are encountered in that operation, and for correcting its faults, if there be any, let us carefully survey the several accidents and difficulties, as well as the causes of death, which are generally met with.

With regard to the passing of the staff, great attention and care must be paid to its use in children, as a false passage is readily made, so that the instrument enters the pelvis below the bladder instead of passing into it; and in some rare instances unusual force has separated the urethra from the prostate. Hence we are never to operate unless the staff is felt in contact with the stone. In children prolapse of the rectum is also very frequent; the gut must be returned, and the sphincter allowed to contract, before operating. The presence of the cicatrix of a former operation need not interfere with a second or even a third incision in the same situation. On several occasions at Guy's Hospital lithotomy has been performed on the same patient two or three times along the original seat of incision, and without difficulty.[1] Some recommend fresh incisions to be made on the side of the perineum, should there be much induration and rigidity, with fistulous abscesses and sinuous tracks; or the surgeon may dilate, if possible, the original opening, cutting along the finger among the altered structures, guided, of course, by a staff in the urethra. If a perineal hernia exists, it is liable to be cut into; but these cases are exceedingly rare, and the accident is scarcely to be avoided.

Enlarged superficial vessels, or the transverse perineal artery, may be wounded and bleed, but are readily tied, if necessary; with care and due attention

[1] On this subject see *infra* the table of cases of relapse of stone occurring at the Norfolk and Norwich Hospital, with remarks by Mr. C. Williams, p. 856.

the bulb and its artery ought not to be injured (except in cases of very deep perineum), and the accident is mainly due to too great haste and anxiety to enter the groove of the staff early; when the bulb or its artery has been wounded, it is best to proceed with the operation, and endeavor to secure the bleeding vessel afterwards, by means of the tenaculum, or compressing forceps: of course, if the hemorrhage be violent, the vessel must be secured without delay.

During the second step, several serious accidents may arise; for if the knife be carried too much outwards, under the ramus of the pubes, the pudic artery may be wounded; or if carried too much inwards, with a full rectum and prolapsus of the organ, that tube may be involved; and lastly, which is by far the most important point, there may be too great or too little section of the prostate gland, and wound of the prostatic plexus of veins. In wounds of the internal pudic artery, it is best to request an assistant to compress the artery against the pubes, and to complete the operation of extraction, when the artery may be attempted to be secured by ligature; should this fail, a short gum catheter, around which some oiled silk is fixed, like to an umbrella, is to be introduced into the wound, and the space between it and the catheter plugged with lint, cotton, or charpie; this is the *canule à chemise* of Dupuytren. Sometimes there is an unusual distribution of vessels; but the case must be treated in the same manner. Where there is general oozing and venous hemorrhage, cold water and ice [or hot water] to the perineum and above the pubes are useful.

The wounding of the rectum has occurred to some of our best operators, during the struggling of the patient, when chloroform was not in vogue; sloughing of the rectum from bruise and injury during the extraction of a large stone has also taken place. The urine will flow in part by the rectum, and a natural cure cannot readily take place. The earlier the sphincter is divided, as for the cure of complete fistula in ano, the better will be the patient's chance of being freed from an annoyance.

With regard to the section of the prostate gland, much weight is attached to the amount of its division in adults; whereas in infants and young children there is no such fear, as the gland is but rudimentary. Sir H. Thompson (op. cit.) remarks, that "the prostate is so exceedingly small as to be almost always, if not invariably, cut wholly through in lateral lithotomy, yet without the occurrence of any accident. Indeed, it is not possible that either forceps or finger can pass into the bladder unless the incision exceeds the thickness of the organ." Again, in children a difficulty may arise from the staff having escaped from the urethra by a false passage, so that the knife cannot be guided into the bladder; or the urethra may be separated from the prostate; or again, the bladder may recede before the point of the knife: in the two former cases the staff must be partially withdrawn and manipulated, so as to reach the bladder by the natural passage, and a grooved director introduced through the wound may sometimes be passed. When the bladder recedes before the knife, so that the finger cannot be made to enter the viscus, Liston suggests the use of a searcher, whereby he would pull the opening of the bladder, as it were, down upon the finger; should, however, it be possible to introduce the bent first joint of the finger, the bladder can be pulled down and the stone felt. In the adult, the section should never exceed the external limits of the prostate; this has already been alluded to. Sometimes the patient is remarkably corpulent, and has a deep fatty perineum, and probably also an enlarged and rigid prostate and a receding bladder, making a very long space to be traversed, so that there is difficulty in making the internal opening freely, and the finger will scarcely reach the prostate; in such cases, a probe-pointed knife may be introduced to complete the section—a lithotome may be used; but by far the most judicious proceeding is the introduction of a blunt gorget, carefully directed onwards to the bladder, and not allowed to escape from the staff: in fact, the gorget used formerly to be, and is sometimes now, employed in completing the ordinary lateral operation. A hypertrophied prostate, or one deformed by tumor, may give rise to difficulties; so may also a deformed pelvis. Martineau used the blunt gorget with success. His object in this part of the operation was threefold: to make a small incision in the gland with the knife, to enlarge the incision with the blade of the blunt gorget, and to take time in drawing the stone from the bladder. In so conducting the operation, the gland is not bruised, but torn; the slow introduction of the gorget separates the fibres of the gland and enlarges the incision as far as the deep fascia, without dividing it; for the fascia yields and stretches as the gorget enters the bladder. Sudden violence in the act of introducing the gorget is nearly as much to be deprecated as the violent extraction of the stone. The kind of violence which the blunt gorget, properly employed, inflicts, is well borne by the gland, and symptoms of high inflammation are rare after such an operation.

Respecting the difficulties encountered in the extraction of stone, they are almost innumerable, and must be met according

to circumstances: a few of these we shall just allude to. In cases of large calculi, Liston (op. cit.) maintains that "the single lateral incision affords sufficient room for removal of the stone in nineteen cases out of twenty; and there can be no purpose served, therefore, in always making a cut in both sides of the gland, and thus endangering the emasculation of the individual." He again, however, observes: "Should it be impossible to bring it through an opening on one side of the prostate such as described, without bruising and laceration of the parts, it will then be proper to provide more room for its exit; and this is gained by making the incision on the opposite side of the neck of the bladder. This is done by passing a narrow-bladed and blunt-pointed bistoury along the finger, and directing its edge towards the right tuberosity of the ischium. If the external incision has been well planned, properly made, and of sufficient extent and low in the perineum, there is no occasion for any further division of the skin and superficial parts. No complicated machine is required to make this bilateral division, and it is quite time enough to have recourse to the proceeding when the necessity has been fully ascertained to exist."

Martineau[1] remarks that, "should the stone be large, or there be any difficulty in the extraction, rather than use much force while the forceps have firm hold on the stone, I give the handle to an assistant . . . while the part forming the stricture is cut, which is easily done, as the broad part of the blade becomes a director to the knife; and rather than lacerate, I have often repeated this enlargement of the inner wound two or three times." Some surgeons, more especially recently, have recommended the crushing and breaking up of a large calculus by a lithotrite, or strong crushing forceps, or cutting it in two by appropriate instruments, and then extracting. This has been performed successfully; but great danger and risk is necessarily incurred, for the bladder is generally firmly contracted on the stone, so that the coats and mucous membrane can hardly escape injury. Where it is so large, and the above measures fail, recourse must be had to the recto-vesical or supra-pubic operation. Where the stone is soft and friable, or brittle, crumbling to pieces under the application of the forceps, much of it may be removed therewith, and the rest evacuated by the scoop. The washing out of the bladder with warm water, by means of a syringe and tube, is highly useful, and attended with excellent results, in detaching any débris or concretion from the walls of the bladder without injury.

When the calculus assumes an elongated form, or any unusual shape, careful manipulation with the finger and forceps may shift it into such a favorable position as to allow of its extraction. Where there is much spasm of the bladder, and a kind of hour-glass contraction, it is best to wait a few moments until it has subsided, and then carefully coax the forceps between the calculus and the walls, gentleness and patience being the chief treatment. Sometimes a stone is caught in the upper part of the bladder, and can almost be felt above the pelvis; by gentle pressure in the hypogastric region, it may be made to descend so as to be seized with the forceps. Encysted calculi often give an infinite deal of trouble, and sometimes will defy all efforts at extraction. In extracting phosphatic calculi, the operator must be on his guard, and recollect that sometimes calcareous matter is firmly deposited on the mucous membrane, and any attempt to remove it by the forceps will only tear away the tissue with it. Another point, which is alluded to by Sir H. Thompson, is, that sometimes in elderly patients portions of the prostate gland have been removed by laceration, such as the small rounded tumors in the substance of the organ, and the pedunculated growths met with in this situation.

[And such extractions of pedunculated outstanding prostatic overgrowths are desirable and of great value to the patient, while they do not increase the severity of the operation or add materially to its risk. In connection with the recent discussion of Mercier's operation upon the enlarged prostate, much testimony has come out, both in England and in this country, going to show that the removal of these pedunculated tumors often restores to the patient his power of voluntarily passing water, which he had lost for a varying period previously to the operation. In one case, operated on by myself and Dr. Van Buren, the function of urination was thus restored to a patient who had lost it for four years, relying absolutely upon the catheter during this period.]

The extraction of the stone is attended with more hazard to the gland. In this step of the operation, time must be given for the parts that embrace the stone to dilate; the muscular structure at the neck of the bladder, the firm substance of the prostate gland, and the deep fascia, will each stretch and yield to the sustained efforts of a firm but gentle hand. The gland is sometimes injured in withdrawing the stone, by the forceps em-

[1] Med.-Chir. Trans., vol. ii., p. 411.

bracing a portion of it, and tearing it away from the body. This may be avoided by passing the finger below the forceps, and disengaging the gland from the forceps after the stone is seized.

A nervous or a violent operator, feeling some resistance to his efforts at extraction, redoubles them, until he finds the stone obeying the force that he employs; and the operator, in ignorance of what he is doing, drags the gland before the stone, separates it from its attachment to the deep fascia, and brings it nearly to the external aperture before his efforts succeed. The consequence of such an injurious proceeding is to bruise the gland, to cause it to slough, and to render infiltration of urine almost inevitable, by the laceration of the deep prostatic connections.

Before proceeding to the question of mortality after lateral lithotomy, we will just allude to the complications which may ensue, although the patient has made a good recovery; thus, the wound may not entirely close, and leave a urinary fistula, which must be treated as other urinary fistulæ; incontinence of urine may result, either temporary or permanent. This is not very common: it is mostly met with in children, and may be cured by attention to the passing of the urine and the general health; as age advances, it generally passes off. Key[1] remarks, that "in the young subject partial incontinence will sometimes occur, if the patient is allowed to leave his bed too soon after the operation, before the neck of the bladder is firmly healed and the sphincter has recovered its tone." Impotency, from injury done to the ducts and vesiculæ seminales, is very rare, and is irremediable. Fecal fistula sometimes follows, either from the effects of the knife, or from the sloughing consequent upon bruising of the rectum during the extraction of the stone.

The causes of death after lateral lithotomy are the following:—

1. Death from the shock of the operation, without any discoverable lesion, may occur, as in any of the ordinary operations; it is very unfrequent, generally occurring in old people, and sometimes in children; it seems to depend upon some peculiar condition of constitution and nervous system.

2. Death from chloroform may likewise occur, and the same remarks as just made about shock apply to these cases. Lithotomy in nowise militates against the use of anæsthetics.

3. Death from hemorrhage and exhaustion may ensue, either primarily immediately after the operation, or secondarily some days after, from separation of the plug of coagulum in the wounded vessel, or separation of a slough from a bruised vessel, or the extension of a sloughing wound involving the vessels. Death from primary hemorrhage rarely occurs, and although children can little stand any great amount of loss of blood, yet we sometimes see them rally after having been thoroughly blanched and in an apparently hopeless condition. Liston states that the average is about 1 death in 100 cases of death; M. Begin affirms that hemorrhage is the cause of death in 1 out of every 4 deaths; but this is not so in this country. Although primary and secondary hemorrhage may not *per se* cause death, yet it will so act as to cause great constitutional depression and debility, and consequently prevent the reparative process, and lay the foundation for general decline, or place the patient in a condition favorable for pyæmia.

4. Death from pelvic cellulitis is by far the most frequent in adults. It consists in an acute inflammation of the tissues around the outside of the bladder, more especially the neck, base, and sides; and is generally produced by urinary infiltration into the cellular tissue of the pelvis. Some consider it to be due to too great a section of the prostate, involving the deep pelvic fascia, and allowing the urine to pass directly into the cellular tissue, and thus cause the inflammation; others maintain that the infiltration of the urine is not a mechanical process, but generally follows inflammatory action, and that this inflammation is due to mechanical violence inflicted in removal of the stone from insufficient section of the gland. In some instances death has taken place from cellulitis, quite independent of urinary extravasation. This inflammation may extend by contiguity to the peritoneum, inducing peritonitis; but it generally leads to purulent infiltration, deposits of pus, and pyæmia. The symptoms are those of severe constitutional irritation, attended with rigors, great prostration and anxiety, and soon followed by symptoms of low typhoid fever; the wound assuming an unhealthy aspect, and giving exit to a fetid discharge.

5. Death from acute peritonitis (*per se*) is rare, seldom occurring in adults, but now and then in children, where the anatomical position of the bladder is closer to the peritoneum, so that too large a section of the neck and base of the bladder may involve it. Peritonitis used formerly, to be considered as the most frequent cause of death after lithotomy, but subsequent investigations have disproved this.

6. Death from acute inflammation of the mucous membrane of the bladder

[1] Guy's Hospital Reports, vol. ii., p. 25.

(cystitis), extending to the kidney or peritoneum, is also rare, although Boyer has asserted it to be the cause of three-fourths of the deaths; this is not the case.

7. Death from inflammation of the prostatic veins (phlebitis) and its effects is not unfrequent, and generally occurs in persons of advanced life; the disease does not often set in until after a week or a fortnight, when recovery is hopefully anticipated.

8. Death from pyelitis, or inflammation of the kidney, or suppuration of the kidney, has been also occasionally met with; and at the post-mortem examination the advanced state of the disease has given evidence of its having existed long prior to the operation.

9. Death may also occur from absorption of the products from the urine, thus poisoning the blood and causing rapid death.

Erysipelas, diarrhœa, fever, or any other accidental attack, may render the operation fatal.

Many statistical inquiries have been made respecting the mortality after the lateral operation of lithotomy. These have been recorded by Crosse, Civiale, South, Coulson, and others, to whose works we must refer those of our readers anxious to investigate the subject. For the most part, these statistics cannot be relied upon as offering any direct assistance, except so far as a general survey, in estimating the value of the operation; they compromise compilations, selections, and returns, in which are many faults of omission and commission. This has been alluded to by Sir Henry Thompson (op. cit.), who has attempted to lay before the profession a more correct table, and this table may be used as a tolerably complete epitome of the mortality of lithotomy under British surgeons; it is derived from reliable sources, mentioned in the text of his work, and contains 1827 cases.

Mortality rates at all ages in 1827 *cases of lateral operation, in metropolitan and provincial hospitals.*

	Cases.	Deaths.	Cases.
Norwich (Crosse)	669	91	about 1 in $7\frac{1}{3}$
Since that time	124	15	" 1 in $8\frac{1}{4}$
Oxford	110	14	" 1 in 8
Leicester	90	8	" 1 in 11
Leeds	29	4	" 1 in $7\frac{1}{4}$
Birmingham	102	10	" 1 in 10
Guy's Hospital	230	33	" 1 in 7
St. Thomas's Hospital	200	29	" 1 in 7
University College Hospital	90	12	" 1 in $7\frac{1}{2}$
Cambridge	183	13	" 1 in 14
	1827	229	nearly 1 in 8

Some have based the rate of mortality on the weight of the stone (see Crosse), and have drawn a conclusion that the mortality increases in nearly the same ratio as the weight.

Others, and perhaps with more reason and practical tendency, have considered the mortality in proportion to the different ages of the patients. This also has been done by Sir H. Thompson in the following table. Still even this method is open to objection, inasmuch as a stone may have been formed in the bladder and have remained there a long time previous to the operation.

Mortality rates at different ages.

During the years	Cases.	Deaths.	Cases.
1 to 5 inclusive	473	33	or about 1 in $14\frac{1}{3}$
6 to 11 "	377	16	" 1 in $23\frac{1}{2}$
12 to 16 "	178	19	" 1 in $9\frac{1}{2}$
17 to 20 "	76	11	" 1 in 7
21 to 29 "	86	11	" 1 in 8
30 to 38 "	75	7	" 1 in $10\frac{1}{2}$
39 to 48 "	100	17	" 1 in 6
49 to 58 "	191	40	" 1 in $4\frac{3}{4}$
59 to 70 "	233	63	" 1 in $3\frac{3}{4}$
71 to 81 "	38	12	" 1 in $3\frac{1}{6}$
	1827	229	

We have taken the liberty to make a slight modification of the above, so as, if possible, to show the mortality at the different epochs of life, which may guide us in some measure: but it is somewhat arbitrary:—

Mortality rates at different epochs of life.

	Cases.	Deaths.	Cases.
1 to 5, infancy and childhood, 473 cases, 33 deaths, about 1 in 14⅓ cases . .	850	49	about 1 in 17⅓
6 to 11, boyhood, 377 cases, 16 deaths, about 1 in 23½			
12 to 16, boyhood, with increasing development and setting-in of puberty .	178	19	" 1 in 9½
17 to 29, adolescence and manhood . .	162	22	" 1 in 7⅓
30 to 48, adults	175	24	" 1 in 7⅓
49 to 70, advancing life	424	103	" 1 in 4⅛
71 to 81, advanced life	38	12	" 1 in 3⅙
	1827	229	avr. nearly 1 in 8

We have here inserted a table drawn up by Mr. C. Williams, comprising the cases operated on at the Norfolk and Norwich Hospital, during a period of ninety-eight years, from January, 1772, to December, 1869.

(See Table on page 854.)

970 were male patients, of whom 871 were operated on by lateral lithotomy, with a mortality of 116; 64 by the median operation, of whom 13 died. Lithotrity was resorted to in 34 cases, with a loss of 3; and 45 were female patients, of whom 2 died. The total number of patients on whom some form of operation was performed for the removal of the foreign body amounts to 1015, which gives an average proportion of 10.46 cases per year. The total number does not represent the actual number of patients suffering from stone admitted into the institution during the 98 years, but simply the number operated upon. During that period a much larger number of cases presented themselves, some of whom refused to submit to any operation; others were found to be suffering from disease of important organs — a condition which precluded the hope of a recovery, had any operative proceeding been adopted. The Hospital Reports for the last twelve years show that 205 cases of stone were admitted, and 170 only were operated on.

The lateral method having been performed on so large a number of patients as 871, renders it desirable to abstract that number from the above table, and give the result of that operation at the different epochs of life, in a separate and convenient form.

(See Table on page 855.)

Remarks by Mr. C. Williams.

This table presents 27 cases of recurrence of stone. Lithotomy was performed a second time in 23 instances, and a third time in four. The proportion that such cases bear to the whole number—1015—is one to 37.58.

Twenty-two were cured; five died; five had stone a third time, four were cut and recovered, the fifth was deemed unfit for operation; all the patients were males, no instance of recurrence having shown itself in the female.

Six of the cases were below 10 years of age; two between 10 and 20; one between 20 and 30; four between 30 and 40; two between 40 and 50; three between 50 and 60; eight between 60 and 70; and seven between 70 and 80. One death occurred below 40 years of age, and four above that period of life; the former (38 years of age), died on the 17th day, the cause being unrecorded; of the latter, one, aged 47, died on the 20th day, cause unknown; the second, aged 65, died on the fifth day, cause unknown; the third, aged 70, died of exhaustion on the 74th day, and the fourth case also died of exhaustion on the 14th day.

The second operation took place, in six cases, within one year from the date of dismissal from the Hospital; in nine within two years; in four within three years; in three within seven years; in two within nine years; and in one within twelve years.

In four cases lithotomy was performed three times; in two of these patients, at the expiration of eleven months from dismissal; in one, fifteen months; and in the fourth, thirty-four months.

The lateral operation was performed twice in 17 cases, and three times in two cases. The median preceded the lateral once in one patient, and twice in another patient; and in five instances the lateral preceded the median. One patient was cut twice by the median plan, and another patient once by the lateral, and twice by the median.[1] The operation was performed in all the cases along the original seat of the incision, and without difficulty.

In 18, the calculi were removed in an entire condition; in seven, they were broken previously to extraction; in two instances, where the stones were small

[1] One patient had been operated on *four* times—twice by the lateral and twice by the median.

Table containing an Analysis of all Cases of Stone in the Bladder operated on at the Norfolk and Norwich Hospital during a period of Ninety-eight Years, ending December, 1869.

Compiled by Mr. CHARLES WILLIAMS, Assistant Surgeon to the Hospital.

Age of cases operated upon.	No. of operations.	Recoveries.	Deaths.	Percentage fatal.	Proportion fatal.	No. of operations.	Recoveries.	Deaths.	Percentage fatal.	Proportion fatal.	No. of operations.	Recoveries.	Deaths.	Percentage fatal.	Proportion fatal.
1 to 5	206	189	17	8.25	1 in 12.11	364	342	22	6.04	1 in 16.54					
5 " 10	158	153	5	3.16	1 " 31.6										
10 " 15	81	74	7	8.64	1 " 11.57	127	114	13	10.23	1 " 9.76	623	578	45	7.22	1 in 13.84
15 " 20	46	40	6	13.04	1 " 7.6										
20 " 30	64	59	5	7.81	1 " 12.8	132	122	10	7.57	1 " 13.2					
30 " 40	68	63	5	7.35	1 " 13.6										
40 " 50	65	51	14	21.53	1 " 4.64	206	167	39	18.93	1 " 5.28					
50 " 60	141	116	25	17.73	1 " 5.64						392	305	87	22.19	1 " 4.5
60 " 70	154	116	38	24.67	1 " 4.05	186	138	48	25.80	1 " 3.83					
70 " 80	32	22	10	31.25	1 " 3.2										
Total	1015	883	132	13	1 in 7.68	1015	883	132	13	1 in 7.68	1015	883	132	13	1 in 7.68

Table of Cases on whom Lateral Lithotomy was performed at the Norfolk and Norwich Hospital from January, 1772, to December, 1869 (a period of 98 years).

Compiled by Mr. Charles Williams, Assistant Surgeon to the Hospital.

Age of patients operated upon.	No. of cases.	Percentage of the whole number.	Recoveries.	Percentage of recoveries.	Deaths.	Percentage fatal.	Proportion fatal.	No. of cases.	Percentage of the whole number.	Recoveries.	Percentage of recoveries.	Deaths.	Percentage fatal.	Proportion fatal.	No. of cases.	Percentage of the whole number.	Recoverie	Percentage of recoveries.	Deaths.	Percentage fatal.	Proportion fatal.
1 to 5	185	21.23	169	91.35	16	8.64	1 in 11.56	335	38.46	314	93.74	21	6.26	1 in 15.95							
5 " 10	150	17.22	145	96.6	5	3.4	1 " 30														
10 " 15	73	8.38	66	90.41	7	9.59	1 " 10.42	113	12.97	100	88.50	13	11.50	1 " 8.69	551	63.26	507	92.02	44	7.98	1 in 12.52
15 " 20	40	4.59	34	85	6	15	1 " 6.6														
20 " 30	51	5.85	46	90.20	5	9.80	1 " 10.2	103	11.82	93	90.30	10	9.70	1 " 10.3							
30 " 40	52	5.97	47	90.39	5	9.61	1 " 10.4														
40 " 50	58	6.65	44	75.87	14	24.13	1 " 4.14	178	20.44	142	79.77	36	20.23	1 " 4.94							
50 " 60	120	13.89	98	81.7	22	18.3	1 " 5.45								320	36.74	248	77.5	72	22.5	1 " 4.4
60 " 70	119	13.66	90	75.43	29	24.57	1 " 4.06	142	16.30	106	74.55	36	25.45	1 " 3.94							
70 to 80	23	2.64	16	70.84	7	29.16	1 " 3.42														
Total	871		755	86.68	116	13.32	1 in 7.50	871		755	86.68	116	13.32	1 in 7.50	871		755	86.68	116	13.32	1 in 7.50

Table of Cases on whom Lithotomy was performed a second time at the Norwich Hospital. The Table is intended to show the age in years of each Patient at the time of his being first operated on; the interval in months between the first and second operation; the weight of the Calculi removed; the Result; and some observations on the general character of the Calculi.

By Mr. Charles Williams, Assistant Surgeon, Norfolk and Norwich Hospital.

No.	Age at 1st operation.	Interval between 1st and 2d operation.	Weight of calculi. 1st operation.	Weight of calculi. 2d operation.	Result.	Observations.
1	2½	15 months	℈ijss	ʒj	Cured	The first calculus phosphatic, and broken in the extraction; the second likewise phosphatic, and broken.
2	3	14 "	6 grs.	ʒiijss	"	One small oxalate of lime removed entire at first operation, and a mixed one at the second.
3	3½	24 "	ʒijss	ʒij ℈ij	"	The first calculus was entire and phosphatic; the second likewise phosphatic and unbroken.
4	7	24 "	ʒjss	℈ij	"	A perfect oxalate of limestone taken away on first occasion; a phosphatic one on second.
5	8	17 "	℈vij	ʒivss	"	One entire lithic-acid calculus removed at the first operation, which left a recto-vesical fistula; the second was an entire phosphatic calculus.
6	15	16 "	iij	ʒj	"	Three broken phosphatic calculi extracted at first; on the second occasion the calculus was of the same description.
7	18	8 "	ʒvj	ʒivss	"	One phosphatic calculus, broken into four fragments, taken away at first; and one of the same composition at the second operation.
8	24	24 "	ʒxvj	ʒvj	"	A broken phosphatic stone removed on the first, and the same on the second occasion.
9	31	22 "	ʒj	℈xj	"	First calculus (a mixed one) perfect; an encysted stone left undiscovered, which was removed at the second operation (median), together with one lying loose in the bladder.
10	33	104 "	ʒxvj	ʒix	"	A single calculus of considerable size, consisting of alternate layers of dried blood and calculous material which broke down on extraction, was removed at the first operation; a broken phosphatic one at the second. Lateral lithotomy performed on first and median on second occasion.
11	37	46 "	ʒv	ʒiijss	"	One perfect phosphatic calculus at first operation; also one of the same composition at the second.
12	48	12 "	ʒiij	ʒv	"	One flat lithic acid calculus first removed entire: the stone removed at the second operation was of the same consistence.
13	60	34 "	ʒviij	ʒiv	"	Four entire uric-acid calculi removed on the first occasion, and one of the same material on the second.
14	61	30 "	ʒiv	℈v	"	This man had undergone lithotrity twice previously to the first lithotomy, at an interval of twenty-eight months; an interval of thirteen months existed between the last lithotrity and the first lithotomy. The débris after lithotrity consisted principally of uric acid and phosphates; several phosphatic calculi, many of them broken, were removed at the first lithotomy, as well as at the second; a perineal fistula remained after the former operation; median lithotomy adopted on latter occasion.
15	63	32 "	ʒiv	ʒiij	"	One entire lithic-acid stone at the first and the same at the second operation; had stone a *third time*, but was deemed unfit for operation.
16	66	4 "	℈j	℈viij	"	A broken lithic-acid stone at the first operation, and five capped with phosphates at the second; median lithotomy resorted to in both instances; a perineal fistula resulted from the first, which was cured by the second operation.
17	68	7 "	℈viij	℈vj	"	Five entire and two broken uric-acid calculi came away at the first operation, and two perfect uric-acid at the second, on which occasion median lithotomy was performed.

No.	Age at 1st operation.	Interval between 1st and 2d operation.	Weight of calculi. 1st operation.	Weight of calculi. 2d operation.	Result.	Observations.
18	71	28 months	℥ixss	℥xij	Cured	Three unbroken uric acid calculi were removed on the first occasion, and one large phosphatic one on the second.
19	38	74 "	℥viij	℥iv	Died	One entire lithic-acid calculus at first operation; a phosphatic one at the second.
20	46	12 "	℥xss	℈iv	"	One large entire lithic-acid calculus removed at the first operation, during which the rectum was wounded; and a recto-vesical fistula was present when the second was performed, on which occasion a phosphatic stone was taken away.
21	55	142 "	℥viijss	℥xvj	"	The first was a large oval unbroken uric-acid stone; second was of the same form and composition.
22	60	111 "	℥iv℈ij	℥xxv℈ij	"	The first calculus was a perfect lithic acid; the second, a large *urethro-vesical* lithic-acid stone; symptoms of recurrence of stone showed themselves three years after the first operation, lithotrity was resorted to, and subsequently lithotomy.
23	62	70 "	℈iv	6 grs.	"	One entire and two broken lithic-acid calculi removed at the first operation, and a small angular one at the second, on which occasion median lithotomy was performed.

Cases on whom Lithotomy was performed a third time.

No.	Age at 1st operation.	Interval between 1st and 2d operation.	Interval between 2d and 3d operation.	Weight of calculi. 1st operation.	Weight of calculi. 2d operation.	Weight of calculi. 3d operation	Result.	Observations.
24	7	16 months	11 months	℥ij	℈x	℥iv	Cured	Two entire lithic-acid calculi were removed at the first operation; a phosphatic one at the second, and a perfect oblong phosphatic one at the third. The lateral operation adopted on each occasion.
25	57	78 "	11 "	℥xijss	℈ij	℥ij	"	Five unbroken uric-acid stones at first operation; one phosphatic and broken at the second, and a single calculus of phosphates and urates removed entire at the third operation, which was lateral; the two former were median.
26	59	58 "	15⅛ "	℥ij	℈v	℥ij gr.xv	"	One entire lithic-acid stone at first operation, and one of the same composition at each subsequent operation. The lateral resorted to on each occasion.
27	69	9 "	34 "	℈viij	℈ijss	℥j	"	At the first operation several small phosphatic stones were taken away; a perineal fistula present at the second and third operations, which were performed according to the median plan; soft phosphatic calculi removed on both occasions. This patient had been lithotomized ten years before his first operation at the hospital, by Mr. C. M. Gibson, of Norwich; he had therefore been operated on *four* times, twice by the lateral method and twice by the median. He lived four years after the last operation.

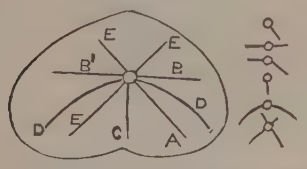
and numerous, some were removed in a broken state, and others were perfect; in one case a sacculated calculus was left undetected in the bladder (Case 9).

It does not appear that the calculus removed at the second operation is necessarily of the same character, in all cases, as that removed at the first; in 18 the second formation was of the same composition as the first, nine being composed of the phosphates, and nine of lithic acid and lithates; the phosphates succeeded the lithates in seven, and the oxalates in two.

Such are the practical points in connection with ordinary lateral lithotomy; we shall now cursorily allude to the several other modes of proceeding in the perineal section, as adopted in this country and elsewhere.

1. Lateral lithotomy modified as regards the section of the prostate:—

Fig. 482.



A Ordinary lateral section of prostate.
BB¹ Boyer's operation.
AB¹ Senn's operation.
C Vacca's operation.
D Dupuytren's bilateral section.
AEEE Vidal de Cassis's quadrilateral section.

Vertical section of prostate, showing the various incisions recommended.

Boyer made a transverse incision of the prostate with the lithotome caché, dividing the gland in its greatest diameter (see fig. 482, BB¹); but the objection to the operation was the division of the perineal vessels, and consequent hemorrhage. Senn combined the two, by making the ordinary oblique incision, through the left lobe, and the transverse one through the right (see fig. 482, AB¹). [The most recent novelty so far as the line of incision of the prostate is concerned is that suggested by Jordan (Brit. Med. Journ., Jan. 24, 1880), who states that he has operated successfully in several cases, making the external incision as in lateral lithotomy, and the internal one directly upwards through the prostate and vesical neck.]

2. The perineal incision, made in a transverse direction and of a semilunar curve in front of the anus. This was advocated by Dupuytren in his well-known bilateral section of the prostate gland in cases of large stone. He divided the tissues towards the symphysis, so as to avoid the rectum; the urethra was opened from above downwards (median) with a double-edged bistoury, and then his curved double lithotome was introduced into the bladder; the blades were then opened and made to cut their way out, dividing the prostate in its oblique diameters (see fig. 482, DD). The results of this operation gave 19 deaths in 85 cases, or 1 in 4½ cases.

3. *Median lithotomy*, where the incision is made in the central line of the perineum, formerly known as the Marian operation. This comprises two modes of proceeding, viz., with section of the prostate gland, or without section of the gland, by merely opening the urethra, with perhaps partial division and incision of the apex of the organ. Vacca was the first to revive the median operation, and he practised a vertical section of the prostate; but, although there was no fear of hemorrhage, the rectum was endangered, so that the operation could only be performed when the stone was small and in adult prostates (see fig. 482, C).

Civiale in 1836 modified this procedure by his medio-bilateral operation. Having made his perineal incision in the median line, he avoided the bulb, and opened the membranous portion of the urethra, when he introduced a straight double-bladed lithotome into the bladder, and by withdrawing it opened, made a transverse section of the gland, as in Boyer's operation.

Buchanan[1] has further simplified this method by the following mode of proceeding: he uses a rectangular staff, which is one bent at right angles three inches from the point, and having a deep lateral groove, with a posterior opening. The instrument is introduced into the bladder, assisted by the left forefinger in the rectum, and thus the angle made to correspond in situation with the apex of the prostate gland, the lower or grooved branch lying parallel to the rectum. The angle rests on the furthest extremity of the membranous portion of the urethra, so that when the knife is plunged into the groove of the staff the membranous portion escapes all injury. The staff is intrusted to an assistant, and the operator, keeping the left forefinger in the rectum, takes a long straight bistoury, holding it in his right hand with the palm upwards,

[1] Edin. Monthly Journal, Feb., 1848.

the blade horizontal and the edge directed to the left; he then enters the perineum opposite the angle of the staff, and passes the knife straight into and along the groove, as far as the stop at its extremity, into the bladder. Next he withdraws the bistoury slowly, making a lateral section of the prostate; but as he does so cuts outwards and downwards, a distance rather more than equal to about one-fourth of a circle round the upper and left side of the rectum, in which organ his finger still remains; an external wound surrounding the corresponding part of the anus about 1¼ inch in length results from the operation. His arguments in favor of this procedure are: 1. the more easy and rapid method of reaching the prostate gland, being only two lines from the surface of the skin, the rectum pressed out of the way, and the knife passed straight forwards into the bladder; 2. the membranous portion of the urethra is avoided and less incision required; 3. all bloodvessels are out of the way, and consequently there is no hemorrhage; 4. the rectum, notwithstanding its vicinity to the incision, is less likely to be injured; and 5. there is less risk of deep-seated infiltration of urine.

Allarton's[1] operation is also performed in the median line, but he does not make any section of the prostate gland, except it be but partial, just incising the apex. The ordinary staff is introduced into the bladder, and then the left forefinger passed into the rectum, so as to feel the staff at the prostate: he transfixes with a straight bistoury the perineum in the median line about half an inch above the anus, carrying the knife on till it strikes the groove of the staff at the membranous portion in front of the prostate; the urethra is pierced at this spot, and after pushing the knife towards the bladder for a few lines, it is withdrawn, at the same time cutting upwards, dividing the urethra a little, and finishing so as to have an external incision of ¾ to 1½ inch. A long ball-pointed probe is then passed into the bladder along the groove of the staff, when the latter is withdrawn, and the left index-finger slided along the probe into the bladder, dilating the prostate and neck of the bladder to the requisite extent, and serving as a guide to the forceps. Where the stone is large he uses Weiss's three-bladed female dilator, or Arnott's hydraulic dilator.

In cases of large stone Vidal de Cassis has advised a quadrilateral section of the prostate gland; he says, "no matter what kind of external incision, as long as it is not too small, whether it be transverse, oblique, vertical, or curved: the point in view is to have one large external incision and many small internal ones. The two first sections of the prostate are to be made along the two inferior oblique diameters of the gland, which will be sufficient when the stone is of moderate size; but when large, the two superior oblique divisions are to be made, first one and then the other" (see fig. 482, AEEE).

We shall now pass on to *lithotomy through the rectum*—the *recto-vesical operation*. This has been recommended in consequence of its supposed readiness of performance, and the easy passage of instruments, besides being free from hemorrhage. The operation consists in placing the patient in the same position as for ordinary lithotomy; a grooved curved staff is then introduced into the bladder, and held by an assistant firmly and perpendicularly, so that the groove is in the median line. The operator takes a sharp-pointed straight bistoury in the right hand, resting the blade flatways on the palm or surface of the left forefinger, which latter is then introduced into the rectum to the extent of 10 or 12 lines. With the right hand the edge of the knife is turned upwards, and its point thrust through the anterior wall of the rectum, so as to gain the groove of the staff, and as the knife is withdrawn, it cuts through the rectum, the external sphincter and cellular tissue covering the urethra and integument in the median line, to the extent of one inch. The left forefinger is next carried into the wound of the sphincter, and the nail inserted into the groove of the staff, when the bistoury, with its edge downwards, is guided along it through the wall of the urethra into the groove, and pushed in the direction corresponding to the raphé, dividing the neck of the bladder and the prostate to a greater or less extent according to the presumed size of the stone; the staff having been removed, the finger is introduced into the bladder, and the calculus extracted by the forceps.

The drawbacks to the operation are the gliding of the mucous membrane of the rectum before the knife, the great risk of wounding the peritoneum and vesiculæ seminales, the subsequent occurrence of urinary infiltration, the passage of feces into the bladder, fistulous sinuses, etc.

Recto-vesical lithotomy was in former years greatly in vogue with the Italian surgeons Vacca Berlinghieri, Giorgi, Cavarra, and others; it was also adopted by the French surgeons Sanson, Dupuytren, etc. By some English surgeons it has been occasionally had recourse to, but is at the present time an operation generally discarded; so much so, that Malgaigne

[1] On Median Lithotomy.

has erased the operation and mode of its performance from his recent edition of Operative Surgery. The best summary and statistics of this operation is that given by König,[1] which we have modified and appended.

Ages.	Cases.	Cures.	Recoveries with fistula.	Deaths.	Proportion of deaths.
Under 5 years	12	8	1	3	1 in 5
From 5 to under 10	13	9	2	2	
" 10 " 20	16	13	1	2	1 " 8
" 20 " 30	5	3	1	1	1 " 5
" 30 " 40	5	4	...	1	1 " 5
" 40 " 50	3	2	...	1	1 " 3
" 50 " 60	9	4	2	3	1 " 3
" 60 " 70	6	6	...	...	... ...
" 70 and over	9	4	2	3	1 " 3
Age not stated	5	3	2		
	83	56	11	16	1 in $5\frac{3}{16}$

The hypogastric or high operation.—Epicystotomia is considered by some surgeons the most direct, short, and least dangerous operation. Its advocates argue that there are no technical or anatomical difficulties, with the exception of the peritoneum, which is easily avoided. It suits all sizes of stone, enables the surgeon to have a free opening into the bladder, and there is not so much danger of infiltration of urine as has been alleged. The wounding of the peritoneum must be regarded as a failure in anatomical manipulation. Pitha remarks, that in male children and young persons below 20, as well as in females, the bladder stands high above the pubes, and presents an uncovered portion freely to surgical manipulation; under 8 years the peritoneal reflection from the bladder does not generally reach lower than 1½ to 2 inches from the navel. In old persons, especially when emaciated, the bladder lies deep in the pelvis, behind the symphysis, and is difficult to reach; hence the impropriety of operating by this method in such cases.

Other surgeons maintain that there is great risk of peritonitis, infiltration of urine, and wound of the peritoneum, and that the operation is only applicable in cases of deformed pelvis; and where there is much fat it is rendered very difficult.

The old method was that of Franco, who introduced a finger into the rectum and pushed the stone up towards the hypogastrium, and its prominence formed the guide for the incision. A more cautious proceeding was afterwards adopted. The preparation for the operation consists in emptying the rectum and distending the bladder, either by the patient retaining his urine or by injecting a sufficient quantity of tepid water to produce distension without over-excess, which latter is best performed under chloroform at the time.

The patient is placed on the back, with the pelvis raised, and the operation is performed in three steps. The first consists in laying bare the anterior wall of the bladder, by a vertical incision in the median line immediately above the pubes, cutting through the linea alba and fascia transversalis, and exposing the loose subfascial cellular tissue, in which some fat is often found.

The second step is that of opening the bladder, and is the most important part of the operation, requiring the greatest precision and care; the opening ought to be made close to the symphysis, and quite in the median line. Some surgeons have suggested and used an instrument called the sonde-à-darde, which consists of a trocar concealed in a catheter. This is introduced through the urethra into the bladder, and then the trocar is extruded and pushed through the fundus of the bladder at the external opening. This is considered both imprudent and mischievous. It is best to transfix the bladder through the wound, and thus secure it. The bladder is then to be opened by a median incision from below upwards. A few authors recommend a transverse incision. The external incision in the meanwhile must be kept open by retractors, in consequence of the tendency of the parietes to contraction.

The third step consists in the extraction of the stone, which may be readily done by a pair of straight forceps.

Civiale uses the sonde-à-darde, and has otherwise modified the operation.[2]

The after-treatment is now confined to simple measures; formerly a gum catheter was left in the bladder, others made a counter-opening in the perineum to drain

[1] König, Journ. der Chirurg. von Graefe u. Walther, Bd. viii., p. 529, 1825.

[2] See Thompson, op. cit., p. 72.

off the water, and some used sutures in the bladder; but it is now considered more judicious to place the patient in bed on the back or sides with the legs drawn up, to employ water-dressing, and nothing else. No catheter, no canula, no other measure, is required.

Vidal recommends the operation to be performed "en deux temps." An incision is to be made in the median line, dividing all the tissues and exposing the bladder; then the operation is to be set aside, and the wound filled with charpie, which is to be replaced daily so as to prevent union. If at the end of six, seven, or eight days there be abundant suppuration, the operation is to be completed by opening the bladder with a straight bistoury, and extracting the calculus.

Supra-pubic lithotomy had at one time many advocates, and it is now strongly urged in those cases where there is a very deep perineum, with enlarged prostate, and a large-sized calculus. The most comprehensive work on this subject is that by M. Belmas,[1] whose carefully collected table of 100 cases will give some general idea as to the success of the operation.

Ages.	Cases.	Recoveries.	Deaths.	Proportion of deaths.
Under 5 years	9	8	1	1 in 25 cases
From 5 to under 10	16	16	0	
" 10 " 20	15	13	2	1 " $7\frac{1}{2}$ "
" 20 " 30	9	8	1	1 " 9 "
" 30 " 40	7	4	3	1 " $1\frac{1}{4}$ "
" 40 " 50	7	6	1	1 " 7 "
" 50 " 60	7	4	3	1 " $2\frac{1}{3}$ "
" 60 " 70	16	6	10	1 " $1\frac{3}{5}$ "
" 70 and upwards	14	10	4	1 " $3\frac{1}{2}$ "
	100	75	25	1 " 4 "

Civiale[1] gives a very unfavorable account of this operation as performed in Paris, for of 75 cases, 35 died, and 35 recovered, and of these latter 5 had a fistula remaining. In 5 cases the result is not given. Gross[2] has constructed a table of 180 cases, but it is probable that many of the cases of one collector is included in that of another. However, we have thought fit to offer the table as it stands in his work.

Table showing Results of 180 *Cases of the Supra-pubic Operation.*

Operative collectors.	Cases.	Cures.	Deaths.	Proportions.
Frère Côme . .	100	81	19	1 in $5\frac{5}{19}$
Douglas . . .	4	3	1	1 " 4
Cheselden . . .	9	8	1	1 " 9
Paul	4	4	0	
Pye	4	1	3	3 " 4
Macgill . . .	4	3	1	1 " 4
Thornhill . . .	16	13	3	1 " $5\frac{1}{3}$
Souberbeille . .	39	28	11	1 " $3\frac{6}{11}$
	180	141	39	1 " $4\frac{8}{13}$

Dr. Humphry,[3] of Cambridge, operated successfully on a boy æt. 14, where the stone was of the size and shape of a small hen's egg, and weighed $1\frac{1}{2}$ ounce. He gives a table of 104 cases, mostly derived from the foregoing ones, and with the following result:—

"In the 104 cases tabulated 31 were fatal, or somewhat less than 1 in 3. The age of the patient makes no great difference in the result, for—

[1] Civiale, Parallèle entre la Cystotomie, etc. Paris, 1836.

[2] Gross, Diseases of the Urinary Bladder, 1855, p. 636.

[3] Trans. of Prov. Med. and Surg. Association, new series, vol. v., p. 102, 1851.

[1] Belmas, Traité de la Cystotomie suspubienne. Paris, 1827.

		Fatal.
In 38 cases	under 20 years . .	. 9
" 8 "	between 20 to 50 years	. 3
" 19 "	from 50 to 70 years .	. 5
" 18 "	above 70 years . .	. 6
83		23

"The cause of death appears to have been generally peritonitis, or infiltration of urine into the loose cellular tissues about the bladder.

"Maund is said to have lost only 5 in 40 operations; and of 100 patients operated on by Frère Côme, no more than 19 are reported to have died. These results are so favorable that I have been unwilling to admit them in the general table."[1]

In taking a general survey or making any critical comparison of the various principal operations and modes of removing a calculus from the bladder, much will depend upon the age and condition of the patient, as well as the size and nature of the stone. In the first place, the great point will be to determine whether the case be fit for the operation of lithotrity. This question, however, is alluded to in the essay on that subject. When lithotomy is determined upon, there can be no doubt for a moment that in children under 12 years of age the lateral operation is the safest and most successful, the mortality being 1 in 17⅓ cases only. Of course this does not preclude the performance of the median operation, where the stone is small or even of moderate size. At puberty and adolescence, and in manhood and adults, from 12 to 48 years, the mortality of the lateral operation rises to nearly 1 in 8, and from 49 to 81 years it amounts to 1 in 4 cases. It is in these periods of life, then, that some other modes of operating have been suggested to lessen the mortality. Statistics have not yet shown so much improvement as might be anticipated. Thus in Allarton's median operation, on 139 cases at all ages, 13 deaths ensued, being 1 in 11; and when restricting this to adults, the mortality was 1 in 7; and in Mr. Williams's report the mortality over 50 years of age is nearly 1 in 2½. Of 60 cases operated upon by Buchanan's method, the result seems to be the same as in Allarton's operation, except that in adults the mortality is 1 in 8.

The bilateral operation of Dupuytren bears a death ratio of 1 in 4½, the recto-vesical about 1 in 5, and the supra-pubic 1 in 3½. These latter proceedings are only had recourse to in cases of very large stone and where complications exist preventing perineal lithotomy.

As far as our present information extends, the median operation may be performed with safety in cases where the stone is small; but the lateral operation is to be preferred in all other cases where lithotrity is inexpedient.

[It is hard to conceive of any case where the stone is small which may not be promptly and effectively dealt with by modern rapid lithotrity with less danger to life than by resort to any cutting operation; therefore the field of usefulness of median lithotomy is steadily narrowing. The two exceptions in which cases of small stone may not be subjected to rapid lithotrity are young children, and cases of deep organic stricture complicated by stone. In the former, lateral lithotomy yields results which cannot be improved. In the latter, a central incision of the stricture, as in the operation of external perineal urethrotomy, will allow rapid lithotrity to be easily and safely performed through the wound. In this way the stricture and stone are simultaneously treated.]

The main issue, as regards the success of any one form of operation, seems, after all, to be chiefly dependent upon the mode of enlarging the opening of the urethra through the prostate and the neck of the bladder. This resolves itself into one of two proceedings; either dilatation of the prostate and neck of the bladder, as in the median operation, or section of these structures, as in lateral lithotomy. Is it safer to dilate, bruise, and lacerate the prostate gland and neck of the bladder, or to make a clean, careful incision with the knife? Small stones are no test whatever as to the value of either mode of operation, nor are calculi in children; for in the latter, whichever mode is adopted, a recovery is expected.[1] It is in adults that we are always trying to lessen the mortality after the lateral

[1] Dulles, of Philadelphia, in the American Journal of Medical Sciences, July, 1875, and April, 1878, makes an excellent showing for the high operation, strongly advocating a more general adoption of the method and giving some exceptionally good results from his own experience. Rachel, in the same journal (January, 1879, p. 116), reports a case and commends the conclusions of Dulles. Peterson (Med. News and Abstract, April, 1881, from Archiv für Klin. Chir., Band xxv., s. 752) thinks the dangers of this operation are lessened by injecting the rectum as well as the bladder with warm water; also by careful suture of the bladder with fine catgut, under antiseptic precautions.]

[1] Thus, in the last two years, at Guy's Hospital, fifteen children under fourteen years of age underwent lateral lithotomy, without any unfavorable result; and it is not improbable that median lithotomy might have been similarly successful.

operation, and none of the recent improvements seem to have supplied the deficiency. Even in Mr. Allarton's recent table, p. 499, 2d edit., his mortality is 1 in 7.

We should have gladly quoted the table inserted in that work, which consists of 170 cases of median lithotomy, but these do not in the least represent the actual state of affairs; the cases are for the most part taken from all sorts of reports of a successful issue; many known cases of death after the median operation are unrecorded; in two instances the author himself has been obliged, in consequence of the size of the stone, to abandon the operation, and terminate it by section of the prostate gland; which latter proceeding undoubtedly led to the successful termination. Median lithotomy, therefore, necessitates the bruising and laceration of the prostate gland, in cases of stone above a certain size, and in consequence will almost inevitably lead to a fatal result. The lateral section still maintains its position as the safest; it was so with Cheselden, Crosse, and numerous other surgeons.

The most perfect and unique collection of cases of the median operation, performed at a hospital of well-established reputation for lateral lithotomy, will give more insight into the comparative merits of the two operations; and we gladly avail ourselves of the opportunity of presenting to our readers one that has been so formed. By permission of Mr. Williams we are enabled to insert his tables, and thus compare the results of 64 cases of median lithotomy with the last 64 current cases of lateral lithotomy performed at the Norfolk and Norwich Hospital up to November, 1869.

Table of the last Sixty-four Cases of Lateral Lithotomy performed at the Norwich Hospital.

Ages of the patients operated upon.	Cured.	Died.	Total.
Under 5 years	16	...	16
5 to 10	11	...	11
10 " 15	1	1	2
15 " 20	1	...	1
20 " 30	1	...	1
30 " 40	1	...	1
40 " 50	2	1	3
50 " 60	6	1	7
60 " 70	15	4	19
70 " 80	2	1	3
Total . . .	56	8	64

Abstract of the Cases of Median Lithotomy.

Ages of the patients operated upon.	Cured.	Died.	Total.
Under 5 years	11	1	12
5 to 10	4	...	4
10 " 15	4	...	4
15 " 20	1	...	1
20 " 30	1	...	1
30 " 40	5	1	6
40 " 50	1	...	1
50 " 60	7	2	9
60 " 70	14	9	23
70 " 80	3	...	3
Total . . .	51	13	64

Table of Cases on whom Median Lithotomy was performed at the Norfolk and Norwich Hospital. The Table shows the Age of each Patient—the Result—the number of Days under Care after the Performance of the Operation—the Number of Calculi removed from each Case—the Weight and Dimensions of each Calculus—when more than one stone was present, the Dimensions of the largest are given.

By Charles Williams, F.R.C.S., Assistant Surgeon to the Hospital.

No.	Age.	Result.	Days under care.	No. of calculi.	Weight.	Dimensions in inches.			Remarks.
						Length.	Breadth	Depth.	
1	2	Cured	22	1	14 grs.	$\frac{6}{8}$	$\frac{4}{8}$	$\frac{2}{8}$	
2	2	"	35	1	34 grs.	$\frac{6}{8}$	$\frac{5}{8}$	$\frac{3}{8}$	
3	3	"	23	1	14 grs.	...	...	...	
4	3	"	29	1	℥ij	$1\frac{1}{8}$	$\frac{7}{8}$	$\frac{5}{8}$	
5	4	"	29	1	35 grs.	...	...	...	Broken in extraction.
6	4	"	15	1	16 grs.	...	...	...	Broken.
7	4	"	29	3	30 grs.	...	...	...	Small calculi.
8	4	"	36	1	47 grs.	1	$\frac{6}{8}$	$\frac{3}{8}$	
9	5	"	50	1	15 grs.	...	...	...	
10	5	"	22	1	℈ij	$\frac{6}{8}$	$\frac{4}{8}$	$\frac{4}{8}$	
11	5	"	29	1	8 grs.	...	...	...	
12	6	"	22	1	℥jss	...	...	...	Broken.
13	8	"	35	1	℈v	1	$\frac{6}{8}$	$\frac{4}{8}$	
14	10	"	16	1	3 grs.	...	...	...	
15	10	"	29	1	℈v	$\frac{7}{8}$	$\frac{5}{8}$	$\frac{5}{8}$	Removed entire. Lithates.
16	11	"	21	3	℥iij ℈ij	...	...	...	All broken.
17	12	"	28	1	6 grs.	...	...	...	
18	13	"	29	1	℈j	...	...	...	Broken.
19	13	"	36	1	℥ij gr. x	$\frac{3}{4}$	$\frac{3}{4}$	$\frac{3}{4}$	Oxalate of lime. Removed entire.
20	19	"	56	1	℥iij gr. x	$1\frac{1}{8}$	$1\frac{1}{8}$	$\frac{7}{8}$	A perineal fistula remained.
21	21	"	29	1	℥vjss	$1\frac{1}{2}$	1	1	Oxalate; broken.
22	33	"	22	1	℥ij gr. x	$1\frac{3}{8}$	$1\frac{1}{8}$	$\frac{3}{8}$	
23	33	"	15	2	℈xiv	$1\frac{2}{8}$	1	$\frac{5}{8}$	One weighed ℈viij, the other ℈vj. The dimensions of the larger only are given.
24	38	"	36	1	℥j	$\frac{5}{8}$	$\frac{4}{8}$	$\frac{3}{8}$	Broken into 3 pieces; phosphates and lithates.
25	38	"	22	1	℥j	$\frac{7}{8}$	$\frac{7}{8}$	$\frac{3}{8}$	Lithates; slightly fractured.
26	40	"	78	...	℥ix ℈j	...	...	...	Phosphatic; broken into fragments; a fistula remained.
27	47	"	28	2	℥viij	$1\frac{3}{8}$	$\frac{6}{8}$	$\frac{6}{8}$	Lithic acid.
28	52	"	21	3	℥v ℈ij	1	$\frac{6}{8}$	$\frac{1}{2}$	Lithic acid. One removed perfect; the rest broken.
29	57	"	29	5	℥xij ℈ij	1	1	$\frac{4}{8}$	Each weighed about ℥ij.
30	57	"	29	1	℥iij	$1\frac{2}{8}$	$1\frac{1}{8}$	1	
31	59	"	16	1	℥j gr. x	$1\frac{1}{8}$	1	$\frac{3}{8}$	
32	59	"	36	2	℥iv	1	$\frac{6}{8}$	$\frac{4}{8}$	Lithic acid; both removed entire.
33	59	"	63	1	℥vss	$1\frac{5}{8}$	$1\frac{2}{8}$	$\frac{5}{8}$	Lithic acid; entire.
34	60	"	15	4	℥viij	$1\frac{2}{8}$	1	$\frac{5}{8}$	Each weighed about ℥ij.
35	61	"	37	1	℈v	...	...	...	Broken during extraction.
36	61	"	31	10	℥iij	...	...	...	Several were broken.
37	61	"	28	1	℥j	$\frac{7}{8}$	$\frac{6}{8}$	$\frac{3}{8}$	Lithates and phosphates; unbroken.
38	62	"	58	several	℥viij	...	..	...	Some entire; others broken. Lithates and phosphates.
39	62	"	36	1	℈iv	$\frac{7}{8}$	$\frac{6}{8}$	$\frac{2}{8}$	Lithic acid; removed entire.
40	63	"	69	1	℥iv ℥v	$2\frac{5}{8}$	2	$1\frac{4}{8}$	A recto-vesical fistula remained.
41	64	"	50	1	℥iv ℈ij	$1\frac{3}{8}$	$1\frac{1}{8}$	$\frac{6}{8}$	Lithic; entire.
42	64	"	29	1	46 grs.	...	...	...	Phosphates; broken.
43	66	"	42	1	22 grs.	...	...	...	Broken during extraction.
44	66	"	36	5	℈viij	...	...	...	Median operation performed a second time; a fistula remained after the first, which was cured by the second. Same case as No. 43.

No.	Age.	Result.	Days under care.	No. of calculi.	Weight.	Dimensions in inches.			Remarks.
						Length.	Breadth	Depth.	
45	67	Cured	30	1	℥iij ℈ij	1⅜	1½	⅝	
46	68	"	29	2	℥ij	1⅛	¾	⅝	
47	70	"	22	1	℈ij	...	...	...	Phosphatic and broken; a perineal fistula present from a former lateral operation.
48	70	"	37	1	℥iij	1⅜	1	⅜	Lithic; entire.
49	72	"	50	1	℥j	...	...	...	Broken; same patient as No. 47; fistula remained unhealed.
50	73	"	42	several	℥iijss	...	...	...	Phosphatic; all broken.
51	73	"	29	1	℥ix	1⅝	1⅛	1	Entire; coated with phosphates.
52	1½	Died	1	2	℥ss	...	...	...	
53	37	"	13	1	℥vij	...	...	...	
54	55	"	3	2	℈vij	1⅝	1⅜	⅞	Both broken.
55	57	"	11	1	℥j ℈ij	1⅝	1⅜	1	
56	61	"	9	2	℥x ℈ij	1⅜	1⅜	1⅝	Each weighed about ℥v.
57	61	"	9	1	℥ijss	1½	⅞	⅝	Lithic; entire.
58	62	"	18	1	℥vj	1⅜	1⅜	1	
59	64	"	86	3	℥x	...	...	...	Broken previously to extraction; several found in the bladder after death.
60	65	"	11	several	℥ij gr. x	...	...	...	Lithic, all broken; 9 found in the bladder after death.
61	66	"	4	1	℥vss	1⅝	1⅜	⅝	
62	66	"	2	1	℥j	2	1⅛	⅝	
63	66	"	4	1	℥xij	2	1⅜	1	
64	68	"	14	1	6 grs.				

The average number of days that each of the 51 cases of cure was under care, after the performance of the median operation, was 34.

The average number of days that each of the 56 cases of cure was under care, after lateral lithotomy, was 42.

In 64 lateral lithotomies 8 died, or one death to seven recoveries. In 64 median lithotomies 13 died, or one death to four recoveries. The average number of days each case survived the former operation was ten, the latter fourteen.

The Number and Weight of the Calculi removed from those who died after Median Lithotomy.

Under five years (æt. 1½)	1 calculus, weighing	℥ss.
From 30 to 40 years	1 " "	℥vij.
From 50 to 60 "	2 calculi "	℈vij.
	1 calculus "	℥j ℈ij.
From 60 to 70 "	1 " "	grs. vj.
	1 " "	℥vss.
	1 " "	℥j.
	1 " "	℥xij.
	1 " "	℥vj.
	1 " "	℥iiss.
	2 calculi "	℥x.
	3 " "	℥x ℈ij.
	several "	℥ij gr. x.

The Number and Weight of the Calculi removed from those who died after Lateral Lithotomy.

From 10 to 20 years	1 calculus, which weighed	℥iij ℈j.
" 40 " 50 "	1 " "	℥ix.
" 50 " 60 "	2 calculi, weighing	℥ij.
	1 calculus "	℥ivss.
" 60 " 70 "	1 " "	℥j.
	1 " "	℥iv ℈j.
	1 " "	℥x.
" 70 " 80 "	1 " "	℥iv.

Remarks by Mr. Williams on the cases of median lithotomy.

Two cases were cut twice by the median plan, at intervals of nine and four months respectively.

In no case did recovery result when the calculus exceeded 3 drachms 2 scruples; except in one case, in which the stone weighed upwards of 4½ oz., but a portion of the rectum and perineum sloughed, and a perineo-recto-vesical fistula was established.

In no case did a cure result when the long diameter of the calculus exceeded 1½ inch, and the short 1¼ inch, except in the case in which the stone weighed upwards of 4½ oz.

Calculi in the prostate gland.

The prostate gland, like other glands, is liable to an inspissation of its secretion, producing small yellow, sometimes red, pale or colorless bodies scattered throughout the follicular structure. These at first are said to consist entirely of organic matter, which Virchow believes to be derived from a peculiar insoluble protein substance mixed with semen; but sooner or later these formations are believed to irritate the mucous membrane, causing phosphatic depositions, which become encrusted upon the organic matter, and thus the genuine prostatic calculi are formed.

Prostatic calculi, therefore, have their development and origin in the gland-tissue. Their number varies from 1, 2, 3, to 100 or more, like a bag of marbles. Their size may be that of grains of sand, or may increase to that of a poppy-seed or cherry-stone. As they gradually enlarge, they come in contact with each other, and undergo a degree of attrition, whereby they form facets or articulations, and the surfaces are often rendered as smooth as porcelain.

Their form, then, generally is very irregular, sometimes triangular, square, etc.

Their color is generally that of brown chestnut, sometimes whitish, black, or red; the brown coating is supposed to be derived from the secretion of the gland; sometimes they are transparent, pearly, like pearl-barley.

Their structure and consistence also vary; they are sometimes of not very great consistence, and amorphous; but generally in concentric layers around a central nucleus: occasionally with radiating striæ; and sometimes they are compact, firm, and brittle.

Their chemical composition, according to Dr. Wollaston, is:—

Phosphate of lime . . .	84.5
Carbonate of lime . . .	0.5
Animal matter . . .	15.0
	100.0

Although prostatic calculi in their early formation are seated in the gland-substance, becoming enveloped on all sides by its tissues, and forming for themselves a bed in the lateral lobes, and when enlarged encroaching upon the rectum, so as to be felt by digital examination; yet more frequently they distend the prostatic ducts, converting them into pouches, and appear at their open mouths, so as to be felt by the sound in its passage along the prostatic portion of the urethra. These calculi may project into the urethra, and thus have a free urethral surface and an adherent prostatic portion. Either of these surfaces may become enlarged, the prostatic portion attaining the size of an ordinary urinary calculus, and its urethral portion may extend backwards into the bladder, forming a prostato-vesical calculus.[1]

Sometimes one or more prostatic calculi may be detached from their recess and lie free in an open duct.

The other forms of calculi in the prostate are derived from a very different source; thus, a urinary calculus may escape from the bladder when small, and become lodged in the prostate: this may either obstruct the canal, or may be expelled along the urethra; or it may form a bed for itself in the prostate gland either by ulceration or pressure. These calculi are readily recognized on section as presenting all the characters of the ordinary urinary calculus, and as being totally different from the true prostatic calculus. But they so far resemble each other, that where a urinary calculus becomes lodged in the prostate, the successive deposits hereafter ensuing consist of phosphate and carbonate of lime; so that in external appearance they are somewhat like that of the true phosphatic calculus. After lithotrity, and even after lithotomy, fragments of stone may become arrested or left in the prostate; so that after one, two, three, or more years, a prostatic calculus may be developed, the nucleus being a fragment of a urinary calculus.

There is one other rare variety (the vesico-prostatic); it is that in which a vesical calculus is situated in the bladder, near its neck, which on increasing in size sends a prolongation through the vesical opening of the urethra into the prostate gland. Here again it enlarges, both vesical and prostatic portions increase, and

[1] See collection of cases in the Guy's Hospital Reports, 3d series, vol. iii., p. 351.

their bar of union remaining stationary produces the same condition as is observed in the prostato-vesical variety, viz., a dumb-bell or bar-shot-shaped appearance. It is singular that in the majority of instances the urethra above was perfectly pervious, allowing a free flow of urine and the passage of a sound over the stone.

The symptoms depend, of course, upon the size, number, and situation of the calculi, and vary exceedingly; being sometimes very slight. Indeed in some instances there have been no symptoms whatever, and the presence of the calculi was only ascertained after death: when the calculi are large, and encroach upon the urethra, there is a sense of pain and weight in the perineum, and frequent micturition, irritation and uneasiness at the neck of the bladder; the prostate may become inflamed, and abscesses follow. Sometimes there are continual semi-erections of the penis, and difficulty in the emission of semen.

The diagnosis is arrived at by exploration of the urethra by means of a sound or lithotrite, and the introduction of the finger into the rectum. Soft bougies of a large size have been recommended, which are to receive the impressions of the stone; but these impressions may become obliterated on withdrawal of the bougie.

The treatment will consist in removing them by means of a properly constructed forceps,[1] when the calculi are small and free; but, generally speaking, an external incision is requisite. The operation is conducted in the same way as for lithotomy, with these exceptions: the incision is to be made in the median line, and should include a sufficient section of the prostate for the escape of the calculus. If there are no symptoms, some recommend that the case should be left alone; others advise that when the symptoms are urgent the calculus should be pushed back into the bladder: this latter suggestion only applies to lodged urinary calculi or fragments of calculi, where the urethral forceps have failed. Where the stone has attained a large size, lateral lithotomy must be performed.

Calculi in the urethra are for the most part derived from the bladder and kidney, or from fragments of calculi becoming arrested at the narrower parts of the canal, more especially the membranous portion, there lodging and setting up various symptoms. However, in some very rare instances the calculus may be formed in the urethra, in this wise: urine collects behind a stricture or constriction, and a pouch or diverticulum thus ensues, wherein urinary deposit may take place and form the nucleus of a calculus, generally of the lithic-acid variety; but it is more probable that a particle of calculous matter or small particles of gravel have become arrested in this pouch and given rise to stone.

The size of the stone varies; where there is only one, it is generally of a larger calibre than the urethra in its transverse diameter, and assumes an elongated form; they may acquire a very large size; where there are several, they are often small and facetted, generally plane and smooth.

The symptoms are very variable—in some cases there are none at all; in others there is acute pain at the site of the calculus, and if this be rough, the pain is very excruciating. The urine may escape freely, or it may be passed frequently, or there may be a frequent desire with inability to micturate, or there may be actual retention; this latter symptom is more frequently present where the stone is lodged in the fossa navicularis. When left alone, dilatation of the urethra ensues, excavations and pouches are induced, ulceration of the urethra follows, and sometimes rupture, causing infiltration and extravasation of urine, involving the scrotum; this is attended with high irritation, fever, and constitutional disturbance. Suppuration may follow, and the abscess burst externally, allowing the exit of the stone, which is succeeded by urinary fistula. Ischuria and enuresis may likewise be produced; and in some rare instances suppression of urine and uræmia may follow.

The diagnosis is generally easy by careful exploration of the canal with a small-sized sound or a long probe, the finger at the same time being passed along the outside of the canal, so that when the instrument impinges upon the stone, the finger may be placed on its vesical side, so as to prevent the pushing back of the stone and its slipping into the bladder. Rectal examination is oftentimes of service.

The treatment by endeavoring to facilitate the escape forwards by means of suction and insufflation, as practised in former years, is obsolete, and inefficient for its purpose. There is always a gradual tendency of the urine to push the calculus forwards; hence the surgeon often directs compression of the urethra to be made in front at the moment of micturition: when the urine has been retained in the bladder and urethra as long as possible, the compression is to be suddenly withdrawn, and the calculus may often follow in the gush. This failing, a warm bath should be or-

[1] Such as Weiss's long urethral forceps, 8½ inches long; the ends of the blades are not pointed, should not meet each other, and should be slightly scooped; or Weiss's canula forceps.

dered, and the urethra dilated with a bougie, which may prove successful. The case, however, generally resolves itself into the attempt at the removal of the calculus by instruments passed into the urethra; and here numerous instruments have been devised both in this and in other countries, and with some satisfactory results. In some instances these have succeeded in their object; in others a failure has been experienced. We must bear in mind that too much endeavor at extraction by means of forceps is bad, and detrimental to the canal and the patient. The quickest, easiest, and safest remedy, after failure of the forceps, is the incision in the median line over the seat of the stone. Make a good long clean cut at once down upon the stone, and turn it out, taking care it does not slip back by planting the finger or thumb of the left hand firmly upon the urethra behind the stone. There is no risk from a clean incision either of extravasation or fistula; for the incision generally heals quickly without trouble, and without any subsequent stricture or fistula. When the stone is opposite the scrotum, provided it cannot be extracted per urethram, it is best to push it back into the perineum, and thence extract it by incision. Incisions into the urethra in front of the scrotum are very often difficult to heal, and leave a fistulous opening. Should the calculus slip back into the bladder during the median operation, a long pair of slender forceps may be introduced, and the stone removed.

[None of the various forms of forceps or scoops for the extraction of urethral foreign bodies have yielded satisfaction in my hands. The general rules which it seems to me may be wisely followed are these: A small stone deeply seated should be gently pushed back into the bladder, if possible, by using a very large blunt sound or a catheter open at the tip, through which opening the urethra may be flooded with warm oil when the instrument comes against the front face of the stone. A small stone in front of the triangular ligament should be evacuated if possible by free use of beer or Bethesda water, and compression of the front part of the urethra during straining at micturition. Then suddenly the pressure is let up, while the straining is continued, and the stone may be swept out.

If the stone is not dislodged by these methods, I know of no instrument so useful in effecting its extraction as the two-bladed stricture divider of Thompson, which may be inserted past the foreign body upon a whalebone guide, opened gently, and then slowly closed and extracted with the stone, which has fallen between the blades.

Large stones anywhere in the urethra require an incision of the canal for their prompt and safe removal.]

Calculus in the female, although not very frequent, is by no means so rare as is usually supposed. The peculiar anatomical arrangements of the urethral canal from the bladder to the exterior render any obstruction to the passage of a small calculus comparatively unfrequent; there is no prostate gland, and there are no natural contractions of the canal; the urethra is short and readily dilatable; there is scarcely any curve. So that although females may be prone to calculous deposition, as well as males, yet they escape the dire consequences of its retention in the bladder by the above arrangement of the parts. We cannot judge of the frequency of the disease in females as compared with males by the proportion of cases operated upon; for in the one instance a large proportion of the calculi escape, or are removed by dilatation without operation, while, on the other hand, nearly all the males undergo lithotomy or lithotrity; and hence we have no data to rest upon.

The symptoms, when a stone has become so large as not to escape from the bladder, will consist of many of those already detailed in the male; but the special symptoms in the female consist in,—1st, bearing-down pains and pains along the urethra; 2d, incontinence of urine. These are sometimes very distressing, and call for urgent attention.

The symptoms often simulate those of uterine disease, for which they are not unfrequently mistaken; so that the surgeon should be on his guard, and on failing to detect uterine mischief, he is bound to pay special attention to the bladder and rectum. Sounding and vaginal examination seldom fail to detect the stone.

The natural progress of calculus in the bladder which is not expelled by nature, and where no remedial measures have been resorted to, will be the ulceration of the stone through the bladder into the vagina, by which a cure is sometimes effected, but at the expense of a vesico-vaginal fistula; a circumstance which is always to be avoided if possible.

The methods for extracting calculi from the female bladder are the following:—

1st. *Urethral dilatation.*—This mode is often performed by natural means, and even calculi of large size have been expelled through the urethra. Thus, there is a case on record where a young girl, æt. 18, passed spontaneously a very large calculus, 2⅝ inches long, 1⅜ inch broad, 1¼ inch thick, and weighing 651 grains.

She made a good recovery and escaped any after bad consequences.[1]

The dilatation may be artificially performed by the surgeon, either by the slow or rapid process. The slow, gradual, and gentle method is very tedious, and consists in the introduction of solid or flexible bougies, gum-elastic catheters, prepared sponges, etc., the use of dilators, the speculum or blunt gorget,—increasing the dilatation to the extent that the calculus may be removed with the forceps. The second method is that by rapid dilatation under chloroform by means of Weiss's dilators, so that the stone is removed by one sitting:—this proceeding is the one usually adopted nowadays, and has been successfully performed in the extraction of very large stones, without any subsequent incontinence of urine. The author removed several calculi from the bladder of a female, æt. 57, by this means, and with success, without any incontinence resulting. The largest of the calculi measured 5½ by 4¾ inches in circumference, and 1¼ by 1½ inch in diameter, and with the lithotomy forceps applied, measured not quite 2 inches.[2]

Mr. Bryant[3] has furnished a very excellent account of this method, with a table of 28 cases, some operated on by the slow and others by the rapid process. He strongly advocates rapid dilatation.

2d. Dilatation with partial division of the urethra where dilatation has been carried on to its proper limits, and yet the stone is too large for extraction, and division by the knife is necessary. This is seldom necessary.

3d. Lithotrity—alluded to in the ensuing section. The operation under chloroform is readily performed, and the fragments removed at once: the author has had several very successful cases of the kind; the lithotrite of course requiring to be adapted to the age of the individual.

[Rapid lithotrity with the large Bigelow tube may be successfully applied in the female without the risk of subsequent incontinence, which sometimes attends excessive dilatation of the urethra for the extraction of stones, and with entire removal of all fragments at a single sitting in a great majority of cases The operation is much more simple than in the male, and almost entirely devoid of danger, immediate or remote.]

4th. Lithotomy. The patient under chloroform is placed in the same position as for males, and a grooved staff is introduced into the urethra. A bistoury and proper forceps are all that are required. The following are the several modes of performing the operation: (1) Urethral lithotomy, the most common and ordinary method, has been executed in every possible direction, generally implicating the neck of the bladder. The incision into the urethra most frequently practised has been analogous to the lateral operation for lithotomy in males, viz., by introducing the knife into the groove of the staff and cutting downwards and outwards at an angle of forty-five degrees. This is called the oblique lateral or unilateral operation; the objection to it is the unavoidable subsequent incontinence of urine. Others have recommended a bilateral section of the urethra, but this has been attended by the same result. Liston modified this operation, for he only notched the neck of the bladder on both sides towards the ramus of each os pubis, and then dilated. A transverse incision has been performed, but without any additional success, and again, the urethra has been divided vertically, by some in the direction upward towards the pubes, but the space was found too small, even with subsequent dilatation; and by others downwards, as suggested by Chelius.

(2) Attempts have been made to extract the calculus by opening the bladder directly, as suggested by Celsus. This operation consists in making a transverse incision between the symphysis and urethra, and thus attacking the anterior parietes of the bladder; and M. Lisfranc modified this into a curved incision, under the name of the vestibular operation; these operations have found no recent advocates.

(3) The calculus has been removed by incision through the vagina; a very easy and expeditious operation, but which is followed almost necessarily by vesico-vaginal fistula and incontinence.[1] Some make the incision longitudinally, and others in a transverse direction. M. Vidal's experience is derived from thirty operations without any death; he introduces a staff through the urethra into the bladder which is held in the median line and its convexity made prominent in the vagina; a blunt gorget is next passed into the vagina deeply, so as to depress

[1] Guy's Hospital Reports, 1st series, vol. iii., p. 167, with plate.

[2] Med. Times and Gazette, Nov., 1868, p. 582.

[3] Med.-Chir. Trans., vol. xlvii., 1864.

[1 Dr. T. A. Emmett, of New York, who has advocated this operation, states that the wound in the vesico-vaginal septum closes very promptly and quite certainly, provided its edges be kept free from accumulations of phosphates, by irrigation through the urethra. He advocates keeping the wound open so as to drain the bladder and give it rest, and believes that it is often difficult to prevent spontaneous closure from occurring too rapidly for the good of the patient.]

the inferior wall of the vagina (a speculum with one valve will do), and with the left index-finger the groove in the staff is felt, and the bistoury plunged into it, taking care to avoid wounding the urethra; the stone is extracted by the forceps; a female catheter is introduced through the urethra into the bladder: and the edges of the wound in the vagina brought together by suture. M. Vidal remarks that there is generally no hemorrhage or peritonitis; but that fistula often follows.

Vaginal lithotomy has recently had some warm advocates, and is considered by them as the only justifiable operation for stone in the female bladder. The whole subject has been thoroughly investigated by Dr. Aveling:[1] he enters into the literature of the subject, and describes the operation minutely. The wound made in the operation is to be treated on the same principles as in the operation for vesico-vaginal fistula. The mortality is stated to be 1 in 35.

(4) It has been recommended to remove the calculus by the supra-pubic operation, and the same remarks as were made respecting the male will hold good for females.

Statistics respecting stone in the female, the operation and its consequences, and the mortality after operation, are incomplete and unsatisfactory.

Calculi in the bladder, obstructing labor.[2] —The accoucheur may not be aware of this foreign body until the period of labour; when, being seated either before the presenting portion of the child or between it and the arch of the pubes, it forms an impediment to the progress of the fœtus. The amount of obstruction of course will depend on the size of the calculus. In the Edinburgh Medical and Surgical Journal, vol. xxxi., 1829, there is a report of a case in which the passage of the fœtus was obstructed by a stone in the bladder, which, when removed after death, was found to weigh 6 oz. 5 dr. and 3 grs., its measurement being $3\frac{3}{8}$ inches long, $2\frac{7}{8}$ broad, and $2\frac{1}{2}$ thick. The nature of the case was not properly understood, not even a catheter was passed to ascertain the state of the bladder; and the child's life was sacrificed by perforation.

Velpeau (Art des Accouchemens, vol. ii., p. 208) relates a case in which a calculus weighing $9\frac{1}{2}$ oz. was removed from the bladder of a woman four months advanced in pregnancy, and who afterwards was delivered without any difficulty.

An obstructing calculus is usually movable in the absence of pain; but it sometimes happens that the tumor becomes firmly wedged between the head of the child and the arch of the pubes.

If the calculus, during the descent of the head, remain at the upper part of the vagina, it will not impede delivery; and the head descending into the pelvis will itself prevent any future obstruction; but if the calculus fall into the neck of the bladder and be placed below the head, the labor will be rendered difficult.

Treatment.—If the calculus be discovered during pregnancy, it should be removed before labor commences; extraction may be practised with safety during gestation. If not detected until the patient be in labor, and if the calculus be small, or if seated in the cavity of the bladder above the head of the child, the case may be left to the natural efforts. But if the stone be large, or if it be placed below the head of the child, we must have recourse to some method of removal.

a. In some cases the stone may be replaced, or rather may be pushed back into the cavity of the bladder above the brim of the pelvis. This *reposition* is recommended by Smellie, Denman, Baudelocque, Dubois, etc.

b. When the calculus is fixed and does not admit of reposition, it must be extracted in one of three ways. 1st. *Dilatation of the urethra.* 2d. *Lithotomy.* 3d. The high operation, or *supra-pubic lithotomy.*

[1] Obstetric Transactions, vol. v., p. 1 et seq. 1864.

[2] Lever, Guy's Hospital Reports, 2d series, vol. i., p. 51.

URINARY CALCULI.

T. HUNTER, LITH. PHILA.

DESCRIPTION OF PLATE.

FIG. 1. *Uric Acid Calculus.*—Showing the two varieties of structure; the external layers are concentric, of a yellowish-brown color; the internal portion consists of the crystalline, radiating, fibrous form, mixed with oxalate of lime, which gives it a reddish hue. The drawing is taken from Plate vi., fig. 4, of the Catalogue of Calculi, in the Royal College of Surgeons, England, but is slightly modified.

FIG. 2. *Urate of Ammonia Calculus*, having a little uric acid, and traces of earthy phosphates disposed in layers. It is of a slate or grayish-fawn color, very brittle, and homogeneous. It was successfully removed from the bladder of a boy æt. 5, by B. B. Cooper.

FIG. 3. *Cystic Oxide Calculus.*—The section shows a confusedly crystalline structure, of a radiating character. It has a yellowish lustre, like wax, is semi-transparent and glistening. After exposure it often assumes a brown-gray or bluish-green color. Taken from Plate iv., fig. 4, Catalogue of Calculi (op. cit.).

FIG. 4. *Oxalate of Lime Calculus.*—Shows the characteristic deposits of oxalate of lime, arranged in an imperfect laminated manner, like fortification agate; its color is of a dark mahogany, mulberry, or rich brown; its exterior is tuberculated and mammillated. Taken from a calculus successfully removed from the bladder of a boy æt. 12, by the author. The boy had no symptoms of stone until two weeks before admission.

FIG. 5. *Uric Oxide or Xanthic Oxide Calculus.*—Copied from Plate xii., fig. 2, Catalogue of Calculi (op. cit.). It is a small fragment of a brownish flesh-color, and its structure disposed in concentric separate layers.

FIG. 6. *Phosphate of Lime Calculus*, with a nucleus of lithic acid; shows the laminated variety, and not that variety which consists of irregular masses like mortar. It is of a grayish-white color. Taken from Prep. 2176, Guy's Museum.

FIG. 7. *Triple Phosphate Calculus*, having a portion of tobacco-pipe as a nucleus. It is confusedly crystalline in part, the rest being compact and laminated, and is of a whitish color. Taken from Prep. 2152, Guy's Museum.

FIG. 8. *Fusible Calculus*, with layers of phosphate of lime. It is like moist chalk, white, more friable and earthy than the other phosphates, sometimes composed of concentric laminæ, and at other times like chalk in texture. Taken from Prep. 2158, Guy's Museum.

FIG. 9. *Alternating Calculus.*—Taken from Plate viii., fig. 11, Catalogue of Calculi, Royal College of Surgeons of England. The nucleus is urate of ammonia, mixed with oxalate of lime; this is followed, first, by oxalate of lime; secondly, by uric acid; and lastly, by alternate layers of urate of ammonia, and the earthy phosphates.

ON LITHOTRITY.

By Charles Hawkins, Esq.

Revised by Edward L. Keyes, A.M., M.D.

[This article stands just as in the last English edition; Dr. Keyes having judged it needless to add anything except an appendix in regard to the method of "rapid lithotrity with evacuation,"—the "litholapaxy" of Bigelow.—P.]

The amount of mortality attending the operation of lithotomy in the adult has always made it a question of paramount importance with surgeons to discover some more successful method of removing a calculus from the bladder.

It is not necessary here to allude to the attempts made from time to time to get rid of the calculi by injecting solvents into the bladder.

The removal of calculi from the bladder through the urethra was effected by Sir Astley Cooper and Sir Benjamin Brodie before the introduction of lithotrity into practice. These surgeons were in the habit of removing small calculi with an instrument called an urethra-forceps. Sir William Blizard is also said to have performed this operation. And in this way patients were successfully relieved of small calculi; in one case, as many as a hundred being thus removed.

To give a detailed account of the early history of lithotrity would now be of little interest. Whether the credit of originating the operation is due to the Spanish monk or to the Indian officer—who both performed an operation on themselves for the purpose of breaking a stone in the bladder—is not now of much importance. It is admitted that to M. Civiale we are indebted for the operation as practised at present.

Among those who have written on the subject, and whose works may be consulted for a history of the operation in all its earlier stages, are Gruithuisen, Elderton, Civiale, Amussat, Leroy d'Étiolles, Heurteloup, King, Costello, Bellinaye, Coulson, and others.

Baron Heurteloup[1] was among the earliest who performed the operation in this country. At first, several instruments were used by him, such as the perce-pierre, trois branches virgule, évideur or forceps, etc.; the intention being to seize the stone, and break it up by drilling holes in it: he eventually made use of an instrument invented by Mr. Weiss, called the sliding forceps, to which he applied a hammer, the stone being broken by percussion. All these instruments and modes of operating have been, for many reasons, superseded by the plan now in general use, viz., crushing the stone by means of the lithotrite.

Sir Benjamin Brodie, who paid great attention to lithotrity on its first introduction, and to whom is due much of the simplicity of the present mode of operating, says, in his "Lectures on the Diseases of the Urinary Organs":[1] "Many years ago Mr. Weiss made an instrument on the principle of what I have called the sliding forceps, having a screw[2] attached to it for the purpose of dividing calculi while still in the bladder into fragments; but it was of rude construction, and, such as it then was, was certainly not fitted for use on the living subject." "Baron Heurteloup at first pursued M. Civiale's method of operating; but finding it liable to some very serious objections, he adopted the principle of the sliding forceps invented by Mr. Weiss, at the same time modifying its shape so as to render it more convenient for being passed into the bladder, and for seizing and retaining the stone afterwards. Besides this he made another change in the instrument,

[1] See Principles of Lithotrity, by Baron Heurteloup. London, Whittaker and Co., 1831.

[1] Brodie's Works, edited by Charles Hawkins, vol. ii., pp. 652–680. Longmans, 1865.

[2] The application of the screw was first suggested by the late Mr. Hodgson, formerly surgeon to the Birmingham Hospital, who early practised lithotrity. He had been a successful operator, having performed lithotomy eighty-six times, with only four unsuccessful cases; he was the surgeon referred to by Sir Benjamin Brodie in his work on Diseases of the Urinary Organs, as having recommended, in lithotomy in the female, division of the urethra immediately below the symphysis of the pubes.

rejecting the screw, and substituting for it a peculiar apparatus which enabled him to crush the calculus by a stroke of the hammer. Now the first of these alterations, made by Baron Heurteloup, I believe to have been of essential importance; in fact, without it, the instrument would have remained wholly inapplicable to any useful purpose. But as to the second alteration I cannot say that anything that I have seen, either in my own practice or in that of others, would lead me to regard it as being any improvement whatever."

Sir Benjamin Brodie in his early operations was accustomed to use an instrument—a scoop lithotrite—so constructed that a portion of the crushed calculus always remained within the blades; by this means a considerable quantity was removed at each operation by the repeated introduction of the instrument. But this method was attended with great objections; the withdrawing the instrument loaded with fragments stretched the urethra beyond its natural size, giving much pain at the time, as well as afterwards. When the urine was passed, it was occasionally attended with some bleeding, and in some instances the urethra was torn, fragments lodging in the torn portion; infiltration of urine, followed by perineal abscess, were the consequences, and in two such cases death resulted. In referring to these cases, in his Notes on Lithotrity in the 38th volume of the Medico-Chirurgical Transactions, he says: "The experience of these cases led me some years since to discontinue the use of the forceps already referred to, or at least to have recourse to it very rarely, and only under some special circumstances, and to substitute for it a forceps made by Mr. Weiss, in which there is a longitudinal opening in the curved part of the fixed blade, with a corresponding projection in the opposite or sliding blade. The effect of this instrument is to crush a calculus very completely, and in such a way that no part of it remains between the blades, the whole being left to be passed with the urine afterwards. The ultimate cure of the patient may in some instances be thus a little (but not greatly) protracted; but this inconvenience is more than compensated by the smaller amount of pain which the patient suffers, the smaller liability to rigors, and the complete absence of danger from the infiltration of urine and perineal abscess."

This instrument, now called the "screw lithotrite," is the one in very general use. Alterations have been made in it. The rack and pinion, applied instead of the screw, was originated by Sir William Fergusson, and is used by that surgeon. Sir Henry Thompson uses an instrument that he strongly recommends. These have been often delineated in surgical text-books. Mr. Coxeter, and more recently Mr. Weiss, have also made alterations, by which it is intended to allow of more rapidity in operating, and to gain lightness in the make of the instrument; but I must confess that, notwithstanding the high authorities in favor of these different instruments, the instrument just described has, I think, still advantages over any other; it is simple in construction, quite as light as it is safe to have it made, and it is not so liable to get out of order as those of a more complicated construction.

It may be as well first to describe the methods of performing the operation, and then to consider the cases to which it may be applied.

When the symptoms are such as to lead one to suspect that a patient has a calculus in the bladder, should there be any considerable amount of irritation of that viscus, and if instruments have not previously been used, it is well to keep the patient confined to the sofa for a day or two before any examination is made; and should the general health need it, to give such medicines as may be necessary.

In examining the bladder, instead of using the sound, the better mode is, having placed the patient on a sofa, with the pelvis raised by means of a pillow, to inject into the bladder through a silver catheter about four or five ounces of water; to the catheter should be attached a stop-cock, so that the water may be retained in the bladder during the examination. If the stone be of any size, it is usually detected by means of the catheter; but should this not be the case, the lithotrite may be introduced, and an examination made in the same manner as will be described when it is used for crushing the calculus.

Having ascertained the presence of a stone, and decided that lithotrity is the operation to be performed, it is necessary to place the patient in as favorable a state as possible for what he has to undergo. One of the first requisites is, that the bladder should be able to contain a sufficient quantity of water to render the necessary use of instruments safe; and it is not unfrequently required, on account of the intolerance of the bladder to a sufficient quantity, to inject the bladder, and keep the water in for a short time on one or two occasions previous to the introduction of the lithotrite. After such treatment the bladder usually retains the necessary quantity. If an extreme irritability should continue, so that at least four ounces of water is not borne, the administration of an injection, containing twenty or thirty drops of laudanum, per

rectum, most frequently accomplishes the desired object. It is also necessary, in some cases where instruments have not been previously used, or where there is any difficulty in introducing them, to pass an instrument a few times on different occasions before proceeding to crush the stone.

The bladder and urethra being thus prepared, the following is the mode of proceeding to be adopted. The patient should take a dose of aperient medicine the day before, and be confined to the house for a couple of days, so that the urinary organs should be in as quiet a state as possible. The patient being placed on a sofa, with the pelvis raised as before described, from four to six ounces of warm water should be injected into the bladder; it is as well to have the piston of the syringe graduated, so as to know exactly the quantity of water injected. Should there be much spasm, so that the bladder resists the introduction of the water, this part of the operation must be conducted slowly, only a small quantity being introduced at first; indeed, if it is found that the bladder will not retain the requisite quantity, the further performance of the operation must be postponed to a future occasion. In some cases, where this intolerance continues, the following plan may be adopted: desiring the patient to retain the urine for as long a time as possible previous to the operation being attempted, and the surgeon being satisfied that a certain quantity of urine is in the bladder, he may introduce the lithotrite, and crush the stone *once;* when a stone has been once crushed, this irritation of the bladder not unfrequently ceases. It is the practice of some surgeons not to inject any water into the bladder before the introduction of the lithotrite. I have found that the bladder more readily retains the water injected than the urine that may be in the bladder when the lithotrite is introduced.

The principal requirement in the operation of lithotrity is, that the calculus should be broken into pieces of such size as may be readily passed; and it is to be considered what is the best method of accomplishing this with as little disturbance to the bladder as possible. The size of the instrument must depend in some measure on the supposed size of the stone, which there is no mode of ascertaining with any very great accuracy; if the stone is not large, a medium size is all that will be required; but should there be any doubt as to the size of the stone, a large instrument should always be used on the first occasion of operating.

The introduction of a lithotrite, from its shape, is more difficult than that of a catheter; and the passage of a lithotrite through the neck of the bladder requires caution and dexterity, and some amount of pressure is occasionally necessary. Where there exists much enlargement of the prostate gland, considerable difficulty is occasionally met with; but with proper manipulation this is overcome. It is of the greatest moment, in this step of the operation, that no attempt should be made to open the blades of the instrument until it is completely in the bladder; much mischief is sure to ensue if such an attempt is made. The next step is the manipulation necessary for the seizing of the stone; on this great authorities differ. Sir Benjamin Brodie, in his Notes on Lithotrity, says: "The rule should be to *move the forceps in the bladder as little as possible*, never using it as a sound for the purpose of exploring the bladder, or ascertaining the position of the calculus. Such an examination does not assist the surgeon in seizing the calculus afterwards; it gives pain to the patient, excites the bladder to contract and expel the water which had been previously injected; and I know that instances have occurred, though not in my own practice, in which a rough handling of the forceps has caused great injury to the bladder, ending in the death of the patient. The rule for seizing the calculus (which I must acknowledge to have first learned from witnessing the very dexterous operations of M. Heurteloup) is as simple as possible. The patient lying on his back, the handle of the forceps is elevated, which of course brings the convex part of the curved extremity of it in contact with the posterior surface of the bladder, where it is contiguous to the rectum. The forceps is then to be opened by withdrawing the sliding blade to a greater or less extent, according to the probable size of the calculus, the fixed blade being at the same time pressed gently downwards in the direction of the rectum. The object of this manipulation is, that the forceps, being below the level of the other parts of the bladder, the calculus may fall into it by its own weight; and it is generally successful. If it should not do so, the forceps without being moved from its situation, may be gently struck with the hand on one side, or on its anterior part, and the slight concussion thus communicated to the bladder will probably be sufficient to dislodge the calculus, and bring it within the grasp of the instrument. If it should be otherwise, the forceps, being closed, may be very gently and cautiously turned to one side or the other, so that the curved extremity of it may make an angle of 25° or even 30° with the vertical line of the body, then opened, and pressed in the direction of the rectum in the manner already described.

"When the prostate gland is much enlarged, there is sometimes a difficulty in seizing the calculus, arising either from it lying under that part of the gland which projects into the bladder, or from the impediment which it offers to the elevation of the handle of the instrument. For such cases the operating-table invented by M. Heurteloup, which enables the patient's shoulders to be suddenly lowered, is very convenient; or the same purpose will be answered sufficiently well if the patient be placed on a light sofa, the end of which may be raised by an assistant. The calculus is then seized, not in that part of the bladder which adjoins the rectum, but in the fundus, this being rendered the lowest point by the elevation of the pelvis."

Fig. 483.

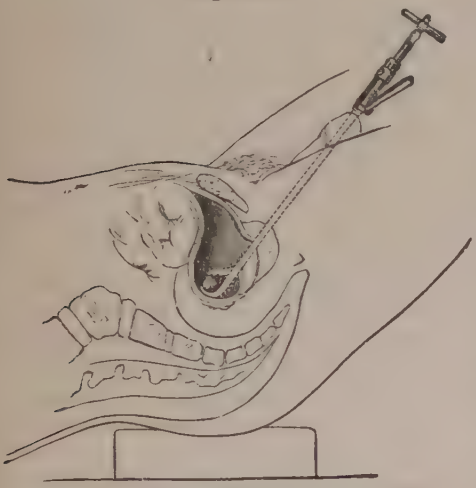


Diagram of the ordinary method (Brodie's) of seizing the stone.

M. Civiale recommends another method, thus described by Sir Henry Thompson in his work on Lithotomy and Lithotrity:[1] "The other mode is that of Civiale. Its principle is the reverse of the preceding. By position of the patient, the centre of the bladder and space beneath it are selected as the area of operation; no depression is made; contact between the walls of the bladder and the instrument is, as much as possible, avoided. The instrument is applied to the stone in the situation which this naturally takes, and the operator carefully avoids moving it, or any movements of concussion whatever, however slight. It is only due to the distinguished operators first named to say that this, the modern, and it is believed the improved, method, is in part due to the mechanical improvements which have been made in the lithotrite of late years. The method was scarcely possible until the present instruments existed.

"We shall now consider it in detail. The blades having entered the cavity of the bladder, the instrument slides easily and smoothly down the trigone, which in the living and healthy organ is an inclined plane, although quite otherwise in the atonied and in the dead bladder.

"In many cases the stone is grazed by the instrument as it passes, and the slightest lateral movement of the blades right or left will determine on which side it lies. If so, the operator is careful not to disturb it, but he inclines the blades *slightly away from the side on which it lies*, carrying the instrument gently in towards the posterior wall of the bladder, while the male blade is slowly withdrawn. It is important always to bear in mind, that as long as the blades are near the neck of the bladder, the male blade cannot be withdrawn, since it would impinge on that sensitive part, and cause pain or injury. Having done so, he now inclines the well-opened lithotrite towards the stone, slowly closes, and almost certainly seizes it.

"But suppose no stone was felt on entering, he is then directed simply to withdraw the male blade an inch or more in the middle line, to incline the blades to the right side about 45°, and then to close them, without altering the axis of the shaft or otherwise disturbing the central position of the instrument. Thus in almost all positions the stone is seized sideways by the blades of the lithotrite, and very rarely by their extremities. If no stone is felt, he turns them, opened, to the left in a similar manner, and then closes them. Observe, that the blades are always to be opened before they are turned, for this reason: if the turn is first made and the blades are subsequently opened, the chance is that the male blade as it is withdrawn will move the stone away; whereas if the blades are inclined while open, the stone, if there, is almost certainly seized. This is one of the many apparently minute but extremely important points of which systematic lithotrity is made up. To return: it is very rare that the stone will elude the search thus far; but if it does, depress the handle of the lithotrite half an inch or so, which raises the blades very slightly from the floor of the bladder, and turn them another 45° to the left, bringing, in fact, the blades horizontal to the left; close: if unsuccessful, turn them gently to horizontal on the right, and close. These

[1] London, Churchill, 1863.

five positions (vertical, right and left, incline, right and left horizontal) explore the bladder fully, middle, right, and left, and will almost certainly find any stone of a moderate size in a healthy bladder. The object is at the same time strictly to avoid communicating any jerk to the instrument or to the bladder. In all these movements, if properly executed, there has been barely contact of the lithotrite with the vesical walls; at all events, no pressure, nothing to provoke undue pain, or cause contractions of the bladder. If, however, there is an enlarged prostate, causing an eminence at the neck of the bladder, a depression behind it, or the stone is very small, or we are exploring for some fragment, at the close of the case, which is suspected to have eluded previous search, the blades may be reversed so as to point downwards to the floor, and the object sought may then often be secured with ease. If seeking for a small stone or for fragments, we shall employ a lithotrite with short blades, which can therefore be reversed with much greater case than one with long blades.

"In order to do this properly in the normal bladder, the handle of the lithotrite is depressed another inch or so, between the patient's thighs, so that the line of the instrument, instead of being directed obliquely a little upwards, is level with, or even points a little below, the horizon; the blades, supposed to have been already brought to the horizontal as before described, are cautiously turned, about 45° say, to the right (right reversed incline), so as to point obliquely to the floor, which should be barely felt, or very lightly touched by them. No pressure should be made on this part of the bladder by any part of the instrument, and it is easily avoided by depressing sufficiently the handle of the lithotrite. Then close the blades; next turn them back, that is upwards, over to the left (left reversed incline), and close. Lastly, they may be brought round, to the reversed vertical position, and the floor lightly swept; this requires the maximum depression of the handle, and is only necessary to pick up small fragments with a short-bladed instrument. But when the prostate is considerably enlarged, and a stone or fragments have to be sought behind it, the lithotrite is reversed without depressing the handle.

"All these movements are to be executed at or beyond the centre of the vesical cavity, the proper area for operating, without hurry, rapid movement, or any other which partakes of the nature of a jerk or concussion, and, if in a fairly healthy bladder, without causing more than a very slight degree of pain to the patient. The operator's eye is also to be so familiar with the scale marked on the sliding-rod, that he knows at a glance the exact interval which it indicates as existing between the blades in the bladder.

"It is essential to good practice, while manipulating the lithotrite, to maintain the axis of the instrument, as far as possible, always in the same direction. The blades only are to be moved; the shaft should occupy the same inclination, unless when this is intentionally altered. In screwing home the male blade, the operator is very apt to move the lithotrite also, at each turn of the screw, unless he is conscious of the care necessary to avoid this evil. All lateral movements, all vibration and concussion, necessarily tell on the neck of the bladder and prostatic urethra, where the instrument is most closely embraced, and its mobility is most limited. To that part of the lithotrite which occupies the anterior portion of the urethra much freedom of lateral movement is permitted, and in the bladder the instrument is free, although in a less degree; but the axis, or fixed point, as regards lateral movement, is at the part indicated, which is also the most sensitive spot of the entire passage. Hence the aim of the operator should be to produce in this situation no motion of the lithotrite, except that on its own axis. Few of the details of the operation require more practice to master than this.

"There is one important rule with reference to the situation of the calculus in the bladder. The larger it is, the more certain it is to be found lying near to the neck of the bladder in the ordinary recumbent position, while a small one is usually detected at the back of the trigone. This position of the large stone requires a different method, and it will be found almost invariably successful. The moment the lithotrite enters the bladder, it is not to be pushed onwards to the bottom of the cavity: first, let the blades be inclined away from the side on which the stone is felt, then push on the female portion of the instrument only, by itself as far as it will go, maintaining the male blade at the neck of the bladder; it is now only necessary to incline towards the stone, and it will be seized almost certainly at once. But if the operator commences by pushing on the whole instrument, and then withdraws the male blade according to the ordinary custom, this blade is infallibly drawn against the large stone, which it therefore fails to catch, and presses it back against the neck of the bladder, producing pain, irritation, and perhaps bleeding: this is a practical rule of importance. As already intimated, for a small stone, the instrument glides down to the posterior wall of the bladder,

the male blade is withdrawn, and the stone caught in the usual manner.

"Such, then, in the main, is the method of Civiale for finding the stone; the other, or English method, is without doubt an efficient one, but I believe it to be more irritating to the bladder, and less certain for removing every minute fragment towards the end of the operation, while it fails to deal efficiently with a stone lying behind an enlarged prostate. Hence the crushing operation has been often said to be inapplicable when such disease exists, a conclusion wholly unwarranted by the practice and results of modern lithotrity. Having tried both methods myself, I have no hesitation in preferring the former."

Fig. 484.

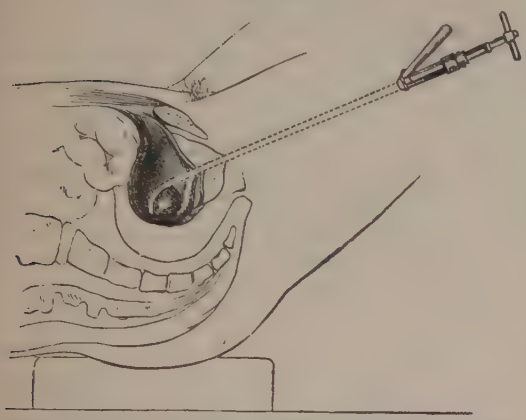


Diagram of Civiale's method of seizing the stone. From Sir H. Thompson on Lithotomy and Lithotrity, p. 177, 1863.

Notwithstanding the opinion thus strongly expressed by one so competent to come to a right conclusion on this matter as Sir Henry Thompson, I am still inclined to prefer and to recommend the method practised with so much success by Sir Benjamin Brodie, as the one less likely to cause irritation of the bladder; and I have not found it attended with the disadvantages described by Sir Henry Thompson.

The calculus being seized by either method, the question then arises—how often should the process of crushing be repeated? In the first operation, the surgeon should often be satisfied with crushing the stone but once, especially if the bladder is irritable. One crushing frequently relieves the patient of much pain and irritation of the bladder, particularly in the case of large stones, and it is well to give the patient as little inconvenience as possible at the first operation, so that he may look to a repetition without dread. On the occasion of first seizing the stone, I usually move the instrument gently to either side, to ascertain if there be more than one stone. The lithotrite being carefully withdrawn—care being taken that the blades are quite closed—the patient should at once go to bed, taking a glass of warm wine-and-water or brandy-and-water, and be kept warm, in order to prevent his having a rigor; he should for the next twelve hours make water in the recumbent posture, and be confined to the house until the next operation.

The period that should elapse between the operations must vary; if at the first operation the calculus has been crushed once only, unless it be a small one, in all probability no fragments will be passed; in which case the operation may be repeated usually in three or four days. During the intervals between the succeeding operations, the patient may be allowed to take a certain amount of exercise.

It is of considerable importance to determine how much should be done at each operation; on this question surgeons differ. Some do a great deal, whilst others are satisfied with seizing the stone only once or twice, and repeating the operation at much shorter intervals. Some place the patient under the influence of chloroform, and continue seizing and crushing the stone until the whole is broken up, at one operation. This latter plan is accompanied with this disadvantage: where a large stone is thus crushed into pieces capable of being passed, the passage is liable to be blocked up with the fragments, which results in a difficulty in getting rid of them, and much consequent irritation of the parts. The wiser plan is to adopt an intermediate method, and to do at each operation so much only as the patient can bear without great inconvenience, so as to render as few operations as possible necessary; whilst on the other hand, the patient is not distressed by the manipulations being continued too long at one operation. From five to ten minutes is the average time the lithotrite should be employed in the bladder.

The interval there should be between the performance of the operations, is the next question to be considered. As a rule, I never repeat the operation whilst any fragments are being passed, and I usually allow one or two days to elapse after the fragments have ceased to come away; this usually requires about a week between each operation.

With regard to the removal of the fragments by means of an instrument, I have

found no reason to alter an opinion I formerly expressed, and which was published in the Transactions of the Pathological Society for the year 1850 :—

"In relation to the occurrence of infiltration of urine, and abscess after lithotrity, Mr. Charles Hawkins thus expresses himself: He believed this accident might be entirely avoided, if the operation of crushing be performed with the lithotrite —that is, if the operator is satisfied with crushing the stone, and not attempting to withdraw the fragments between the beaks of the instrument. He believed this accident never occurred except where the urethra had been lacerated with a piece of stone during the withdrawal of the instrument; then impaction of a fragment led to the results which the preparations exhibit; but where the urethra has not been lacerated, impaction is of little importance, and no dangerous symptoms are likely to result from such an occurrence. . . . Since no attempts have been made to remove fragments from the bladder in the instrument, he had met with no such accident. . . . As far as his experience went, it was not necessary to attempt the removal of stone in the scoop-lithotrite. If the stone is *well crushed*, it may be left to nature for the bladder to be evacuated of the fragments: or where there was a difficulty in passing them, he had removed much by means of washing out the bladder."[1]

It is not necessary to introduce the lithotrite more than once at each operation, if the plan described be adopted; nor is it requisite to draw off the water when the lithotrite is withdrawn. It is desirable that some water should be left in the bladder; it renders it better able to bear the presence of the broken stone. In performing lithotrity, this rule should be invariably followed: *to introduce an instrument into the bladder as few times as possible.*

When there is much enlargement of the prostate gland, and the patient on this account is unable to pass very small fragments, and their removal has not been effected by means of the catheter, the best mode of proceeding is to make use of the scoop-lithotrite; and one end of the sofa on which the patient lies being raised by an assistant, the fragments fall into the instrument at the fundus of the bladder, that part by this plan being now the lowest portion. Mr. Clover has invented a very good apparatus for removing the fragments in such cases.

Among the difficulties that may arise during the treatment of a case are the following: Sometimes after the first operation retention of urine occurs, but not very frequently when the bladder is in a healthy state, and where too much has not been attempted: this must be met in the usual way, by the use of the catheter. A fragment of stone may be retained in the passage, after it has left the bladder, in cases where there has been no laceration of the parts: as before stated, this state of things, although troublesome, is not dangerous; and when the fragment lodges in the membranous or prostatic portion of the urethra, a full-sized gum catheter should be used, and the piece gently dislodged and pushed back into the bladder. Many ingenious instruments have been devised for the purpose of seizing and removing fragments thus arrested; but of all, the catheter will be found the most simple and most useful. Should the fragment be retained in the anterior portion of the urethra, it usually makes its way out in course of time; to facilitate this, the patient should retain the urine for as long a time as possible, and pressing the penis at the other side of the stone for a short time when the bladder is about to act, the piece is washed out. Fragments sometimes lodge just behind the meatus; with a common dressing-forceps they may be removed from this position; in a few cases it may become necessary to make a slight incision in the lining membrane of the urethra. The passing of fragments sometimes give rise to inflammation of one or both testicles; this may delay the operation. The chief cause of mischief to be apprehended is when there is considerable irritation, followed by inflammation of the bladder, the urine depositing a quantity of ropy mucus, giving rise to great pain in the passage of water, and a constant desire to pass it. These cases require very careful treatment; depletion is rarely necessary: with the use of the warm bath and the administration of opium and hyoscyamus, the patient being kept to his bed or the sofa, the attack usually passes off. But these are signs that the bladder will not bear any lengthened operations. This state of bladder is sometimes caused by a fragment of stone, which is both too large and too small—small enough to enter the neck of the bladder, but too large to pass further; in this case, notwithstanding the irritation that may be present, the lithotrite should be introduced and the fragment crushed, when generally the symptoms subside. The bladder will in many cases continue to secrete a quantity of ropy mucus as long as any stone remains, so that there is no reason for not proceeding with the operation; the patient may take daily half a pint of the decoction of the Pareira brava; but the treatment really requisite

[1] Path. Trans., part i. of vol. iii., 1850, pp. 123, 124.

is the removal of the stone. Nevertheless these cases are occasionally not so easily managed, and sometimes it may be necessary to cease all operative proceedings for a time, until the bladder becomes in a more healthy state; it may, indeed, happen that the attempt to remove the stone by lithotrity must be abandoned: this, however, occurs but very rarely; usually with proper treatment, these unfavorable symptoms are overcome, but not always. Sir Benjamin Brodie, in his Notes on Lithotrity, relates the following case:—

In a fourth case, a very small calculus was crushed with great ease by a single operation. The operation was succeeded by a rigor, which terminated, as is usual, in a perspiration. A disturbed state of the system followed, marked by a frequent pulse, a furred tongue, and much prostration of strength; and attended with a deposit of adhesive mucus, but not in large quantity, from the urine. These symptoms continued, and after some time an abscess presented itself in one groin. The abscess having been opened, a considerable discharge of matter took place, and was followed by great relief as to the general symptoms. The patient seemed to be in an improving state, when between four and five weeks after the operation, he suddenly expired.

On examining the body, no remains of the calculus were discovered in the bladder. The mucous membrane of the bladder bore marks of inflammation. There was an abscess of the pelvis, occupying the space between the bladder and rectum, and extending in the direction of the abdomen as high as the groin, in which the puncture had been made. The parts were carefully dissected and examined by the late Mr. Vincent (who had attended the patient with me in consultation), Mr. Charles Hawkins, the Curator of the Museum of St. George's Hospital, and myself; but no lesion could be detected of the bladder, nor any kind of communication between the bladder or urethra and the abscess. Still I cannot doubt that the abscess was somehow the result of the operation. Probably a very small splinter of the calculus might have penetrated the coats of the bladder, allowing the escape of a very minute quantity of urine into the cellular membrane. This would be quite sufficient to account for an extensive suppuration, at the same time that it is easy to suppose that so small a puncture might at once have closed, so as to be invisible afterwards.

In this case the cause of death I believe to have been fatty degeneration of the heart; and had this disease not existed, I have little doubt but that the patient would have got well of the operation.

In those cases where a fragment becomes impacted in the urethra, usually in the membranous portion, and where the parts have been lacerated, in all probability such an accident will be followed by infiltration of urine and perineal abscess; the surgeon must lay open the abscess freely. In two cases where this treatment was followed, the patient ultimately recovered.

The number of times it may be requisite to repeat the operation must necessarily depend upon the size of the stone—the amount of crushing that is performed at each operation—and the facility with which the fragments are passed. Some patients pass very considerable-sized fragments; others require the pieces to be very small, necessitating more frequent operations. In the cases operated on by Sir Benjamin Brodie, with those that have occurred in my own practice, the number of operations averaged between six and seven; one or two operations sufficing in many cases of small stones. Mr. Prescott Hewett has operated in one case as many as nineteen times and with ultimate success.

It is occasionally a wise plan, in cases in which there have been many operations, and the patient begins to feel the confinement and the recurrence of the operations, to cease altogether for a time, so as to allow him to recover his usual health; of course before dismissing the patient as cured, the surgeon must be satisfied, by examining the bladder, that no stone remains. In some cases where the fragments are too small to be seized by the lithotrite, or rather where, from their size, they fall through the opening in the blades of the instrument, and yet do not pass, the introduction of a full-sized catheter (which should be retained in the bladder for a short time) will enable the patient to void them.

The placing the patient under the influence of chloroform[1] is by some surgeons much recommended. As a rule, I do not think it advisable to make use of it, but only to have recourse to it in those cases where circumstances may render it necessary. In ordinary cases there is not only no occasion for it (for lithotrity, if properly performed, is not a painful operation), but, on the contrary, it is as well to do without it, on account of the operator being thus better able to ascertain to what extent the patient can bear the operation at each time, so that he should not proceed so far as to cause the bladder to resent the operative proceedings. The bladder does not retain the water so well when chloroform[1] is employed. When patients are peculiarly sensitive with regard to the operation, chloroform[1] must be administered; for without it such patients could not be induced

[1] Or ether.]

to submit to the operation, however favorable their cases might be in other respects.

I operated on a patient twenty-four years of age, who had symptoms of calculus when a child. They had for many years remained dormant, but had recurred about four years before he had consulted me, at which time he was making water incessantly and with intolerable pain, the urine depositing a large quantity of ropy mucus mixed with blood; in fact, the bladder being in as unpromising a state as possible for any operation. Having seized a very large stone with the lithotrite, I was unable to proceed with the operation on account of the patient being incapable of exercising the necessary control over himself; but, under chloroform, I was enabled to effect a complete cure in five operations. It would have been impossible to have done this without the aid of chloroform. In the 41st volume of the Medico-Chirurgical Transactions, I have related a case in which I operated successfully on a patient in whom there was a communication between the bladder and intestine. The calculus, the nucleus of which was some vegetable matter, was of such a size that I could scarcely seize it with a very large lithotrite. The patient was enduring such dreadful sufferings that he was anxious to be placed under the influence of chloroform; but on the third occasion of operating, it was done, at his request, without chloroform; the operation was borne as well as when chloroform was used, and the bladder held more water.

In such cases chloroform is very useful; but in the majority of cases, it is not requisite, and not being requisite, it is as well not to have recourse to it.

In considering in what cases lithotrity is to be preferred to lithotomy, it may be observed that the early writers on the operation were of opinion, that only where the calculus was very small, requiring but one or two operations—the bladder and kidneys perfectly healthy—was lithotrity available. Further experience, together with the great improvement in the instruments used and in the mode of operating, have tended in a great measure to alter this opinion. No doubt the frequent introduction of instruments, when the fragments were removed within the blades, causing unnecessary disturbance to the bladder, and the stretching and not unfrequently the laceration of the urethra, rendering it in a very unfit state for the passage of fragments, led to most dangerous accidents; but since the practice of removing the fragments within the blades of the instrument has been laid aside, many cases which formerly would have been unfavorable for lithotrity are now successfully treated. The inability of the bladder to expel all the fragments was also considered a state in which lithotrity was not applicable. Yet now, after the stone has been well crushed, these cases can be managed by washing out the débris through a silver catheter. It may be well to mention that the eye of the catheter used for this purpose should always be on the concave side of the curve—for the reason, that if a fragment should chance to lodge in the aperture and not be removable, although on the withdrawal of the instrument the fragment might lacerate the urethra, the consequences that follow such an accident are of much less importance than if the lower part of the urethra were injured. A catheter has lately been invented with the opening in the convex part—for the injecting the bladder—under the idea that the stream of water coming more immediately in contact with the fragments, their removal is more readily effected: which is rather a theoretical than a practical improvement, and the catheter has the disadvantage of having the aperture in the lower curve. There is no doubt that a healthy state of the bladder is very desirable when lithotrity is to be employed; but I have performed it with success when the bladder has been in a very considerable state of irritation and secreting much ropy mucus. This irritation and secretion of mucus diminish as the operations are performed, and nearly cease before the whole of the calculus has been removed. These cases certainly require much caution in their management, still they are by no means cases in which lithotrity is to be rejected. The inability of the bladder to hold the requisite quantity of water might at first deter a surgeon from selecting such cases for the operation; but, on the other hand, a little management, by injecting the bladder for some time previous to operating, generally overcomes this obstacle, and not unfrequently, where a bladder has been very intolerant of water, this inconvenience has subsided after the stone has been once crushed. Where there is serious disease of the kidneys, lithotrity is no doubt as likely to be attended with ill consequences as lithotomy. But cases do occur where the presence of kidney disease would inevitably render lithotomy an unsuccessful operation, in which lithotrity may be employed, if not with entire success, with at least the alleviation of much suffering, and prolongation of life. The worst form of kidney disease, albuminuria, is fortunately not frequently found in combination with calculus in the bladder at the period of life at which it is desirable to perform lithotrity. In cases of very bad stricture of the urethra, rendering the introduction of the lithotrite impossible, lithotomy must be had recourse to; but in cases in which a considerable amount of stricture existed, I have been

enabled, by using a small lithotrite, and crushing the stone very fine, to relieve the bladder of a considerable-sized stone. But now that stricture is so readily removed by Mr. Barnard Holt's "immediate treatment," it ceases to be so serious an objection. Malignant disease of the bladder, in combination with calculus, of course precludes lithotrity as well as lithotomy.

The removal of foreign bodies that have been introduced into the bladder, such as bougies, may be effected with a scoop-lithotrite.

In cases in which the bladder is unable entirely to empty itself, the urine left soon becomes decomposed and ammoniacal, irritating the mucous membrane, and causing it to secrete a quantity of phosphate of lime, or phosphate and carbonate of lime, which, being mixed with the mucus and retained in the bladder, gives rise to great irritability of that organ. In such cases the removal of this soft calculous matter is easily accomplished by means of the scoop-lithotrite. But the cause of the mischief remaining, these formations will constantly recur, and in some instances give rise to the opinion that the surgeon had failed in the previous operation to remove the whole of the formations, which is not always the case. The treatment to be adopted to prevent the formation of calculous matter is the constant washing out of the bladder with warm water. These cases are usually very troublesome; and if this treatment is not persevered in, the disease of the bladder soon sets up disease of the kidney, under which the patient ultimately sinks.

Women are naturally, from the formation of the urinary passages, favorable cases for lithotrity; and the operation is to be performed in the manner that has been described previously for the other sex. The cure in women is less protracted than in men, as the fragments pass more readily. There are obvious reasons why it is desirable that women should be placed under the influence of chloroform. It may be said that with women, with hardly an exception, lithotrity is the method to be employed.

It is very generally admitted that children are not well fitted for lithotrity, and that lithotomy should in their cases be performed, not only on account of the great success attending that mode of operating at an early period of life, but also on account of the necessarily small size of the instruments to be used rendering it difficult to have them made of sufficient power to crush stones of the size frequently found in children, and the almost impossibility of carrying out in them the continuous treatment necessary to bring lithotrity to successful issue.

The composition of the stone is not a matter of very considerable importance; perhaps those composed of oxalate of lime require more force in the application of the lithotrite, and the fragments cause more pain in passing than others; but this is fortunately a calculus not very frequently met with.

In comparing the relative successes of lithotrity and lithotomy, Sir Benjamin Brodie, in his Notes on Lithotrity, makes the following remarks:—

"It would be unreasonable to expect that any method of treatment for the relief of a disease so certainly fatal if left to itself, and productive of so much misery, as calculus of the bladder, should be constantly and uniformly successful. If lithotomy has its dangers, lithotrity has its dangers also; and the only question for the practical surgeon to consider is, which is the least dangerous of the two. Of the nine cases which I have enumerated, it may well be doubted as to one of them whether the attack which was the immediate cause of the patient's death was really connected with the operation; while in two others the fatal result was to be attributed to a mode of performing the operation which my later experience has led me to abandon. But, even if we admit the whole nine cases as a fair example of the average failure of the operation, the proportion of deaths to recoveries is somewhat less than 1 in $12\frac{1}{2}$.

"In order that I might compare this with the proportion of deaths from lithotomy, I have referred to a paper by the late Mr. R. Smith, of Bristol, published in the eleventh volume of the Transactions of this Society, and entitled An Inquiry into the Statistics of Stone in the Bladder; and I there find it stated, that in the Bristol Hospital, during a series of many years, the average of deaths after lithotomy was 1 in $4\frac{1}{2}$; in the hospital at Leeds, 1 in 5; and in the hospital at Norwich 1 in $7\frac{1}{4}$.

"Thirty-five years have elapsed since the publication of these statements, but there is no reason to believe that the success of lithotomy is greater now than it was when Mr. Smith collected his observations. The editor of a weekly journal (The Medical Times and Gazette) has for some time past published the statistics of the various operations performed in the London hospitals, including lithotomy. The facts seem to have been collected with some care, and are probably a near approximation to the truth. Mr. Charles Hawkins has been at the pains to collect from the various numbers of that journal, published during the year 1854, the facts

relating to lithotomy; and it appears that of 59 patients who underwent that operation, as many as 10 died, being in the proportion of rather more than 1 in 6.

"But here two other facts must not be overlooked, without which no just comparison can be made of the results of the two operations. First, while cases of vesical calculus in children under the age of puberty, in private practice, and among the more affluent classes of society, are of rare occurrence, they form the very great majority of those which are admitted into hospitals; and, secondly, the proportion of deaths after lithotomy among children is very much less than it is among adults. Both these facts are sufficiently obvious to those who have had the opportunity of witnessing the practice of our larger hospitals. From the data furnished by the medical journals to which I have already referred, it appears that in the London hospitals during the last year children formed a small fraction more than three-fourths of the whole number of those who underwent lithotomy; that among them the deaths were in the proportion of one to fourteen recoveries; while among adults the deaths and recoveries were equal. That in this instance the large proportion of deaths among adults was beyond the average, and depending on accidental circumstances, cannot well be a matter of doubt, and indeed it is plain that no general rule can be drawn from the limited number of cases which occur in the space of a single year. Still, as even in the Norwich Hospital, where there is reason to believe that lithotomy has been on the whole more successful than in any other public institution, the proportion of deaths among adults is reported to have been four times as large as that among children,[1] it is evident that the difference in the degree of danger at these two periods of life is very great; and it must always be borne in mind that, in estimating the comparative value of the two operations, it is only the results met with in adults that should enter into our calculation."

There have not as yet been any very extensive statistics of lithotrity published. Among the latest are those of M. Civiale, of which Sir Henry Thompson, in his work before referred to, says:—

"Take, for example, the practice of my esteemed and kind friend, M. Civiale, during the last year. It is a fair specimen of his usual experience, which he is good enough to send me annually, and has of late presented to the Académie des Sciences. He treated, during the year 1862, 69 calculous patients—66 men, 2 women, and a child; 45 in private practice, 24 at Hôpital Necker. Fifty-eight of these were operated on: 45 were submitted to lithotrity; of these 8 were partially cured, and it was successful in all the remainder but 1.

"Ten were treated by lithotomy; 3 were cured, 2 relieved, and 5 died. Three were treated by a combination of lithotomy and lithotrity; 2 were cured, the other had incontinence of urine.

"In *eleven cases* operative means have been adjourned or considered impossible.

"Now, although the lithotrity here recorded is extremely successful, every English surgeon will feel surprised to find one in every six adult cases placed in the category last named, and one-half of the lithotomy cases fatal. It must be obvious to all who are familiar with the practice of this country, that nothing like this proportion of cases is adjudged unfit for operation."

It will be seen by the tables so carefully prepared by Sir Henry Thompson, that in 1827 cases of lithotomy, 1116 occurred in patients between the ages of one year and twenty-one years, leaving but 717 from that period up to the age of eighty-one, and of these 462 cases occurred between fifty and eighty-one years, the period of life (at least in private practice) we are most called upon to operate for stone; and in these cases there were 115 deaths—about one in 4 cases. Now if we compare these statistics of lithotomy with those as yet given of lithotrity, it will, I think, leave no doubt in most minds which operation the surgeon should prefer, at least in the large majority of adult patients.

One of the great advantages of lithotrity is, that patients are quite ready to submit to the operation when the stone is small, and when its presence has not given rise to any serious mischief in the bladder or kidneys; when, on the other hand, an operation so serious and so dreaded as lithotomy is driven off, as a last resource.

In reviewing all the bearings of the two operations, I think there is every reason to concur in the opinion expressed by Sir Benjamin Brodie: "My own experience has certainly led me to the conclusion that lithotrity, *if prudently and carefully performed, with due attention to minute circumstances*, is liable to smaller objection than almost any other of the capital operations of surgery. The cases, indeed, to which it is not applicable are very few indeed, and they are chiefly those in which, from the calculus having attained an unusual size, the danger and difficulty of lithotomy are so great that no surgeon would willingly, nor otherwise than as a matter of duty, undertake it."

In conclusion, it may be well to con-

[1] Medico-Chirurgical Transactions, vol. xi., p. 32.

sider how far it may be expedient, in arriving at a decision as to which of the operations should be adopted, to make some distinction between private and hospital patients. The greatest success attending lithotomy is undoubtedly met with in the latter class. These patients being willing to submit to an operation at an earlier period than those in private practice, are consequently in a more favorable state for lithotomy; and not being so amenable to the necessary treatment between the operations of lithotrity as the more educated classes (for lithotrity, although a simple operation in itself, requires, for a successful issue, great care and attention to the most minute points during the whole time the patient is under treatment), when the treatment becomes protracted, they are liable to become unfavorably influenced by hospital atmosphere. To hospital patients *time* is of much more importance than it is to the more affluent; so it may be considered more advisable to have recourse to lithotomy, on these accounts, in hospitals, when in private practice lithotrity would without doubt be the operation selected. Such at least may be the reasons why in hospitals lithotomy is as yet more frequently had recourse to in adult patients than lithotrity.

Being anxious to have accurate information as to the progress lithotrity was making in hospital practice in London, while this essay was originally going through the press, I applied for information on this point to all the London hospitals, and was most obligingly and readily supplied with what I required from all, with the exception of the Hospital for Stone; the authorities at this hospital made no reply to my request. I must also state that the return from University College Hospital is not quite complete, as I failed to obtain any information from one of the surgeons of that hospital. If the numbers reported from University College Hospital be compared with other hospitals of the same size, it will be seen that the number of cases unreported cannot be large. The absence of information from one surgeon cannot in any great degree influence the result obtained by the subjoined table; from which it will be seen that out of 91 adult patients admitted, in two years, into the London hospitals, with stone in the bladder, only 32 were treated by lithotrity: 6 underwent no operation.

Patients with Stone in the Bladder admitted into the London Hospitals in the Years 1862–63.

Hospitals.	Total.	Children.	Adults.	Lithotrity.	Lithotomy.
Guy's	31	15	16	7	24
St. Bartholomew's	25	16	9	3	22
King's College	22	7	15	9	13
London	17	5	12	2	15
University College	16	6	10	5	11
St. George's	13	2	11	3	8
St. Mary's	12	9	3	1	11
St. Thomas's	11	7	4	1	8
Royal Free	7	7	...	...	7
Middlesex	6	2	4	1	3
Westminster	5	3	2	...	5
Metropolitan Free	4	1	3	...	4
Charing Cross	3	2	1	...	3
Sick Children	3	3	...	...	3
Great Northern	2	1	1	...	2
	177	86	91	32	139

Since the above was originally printed I received a communication from Mr. Armstrong Todd, stating that my application to the Hospital for Stone had inadvertently remained unanswered. He was good enough to forward me the following return of patients admitted into the hospital during two years, with stone in the bladder: The total number of patients admitted were 17, viz., children, 5; adults, 12. Lithotrity performed on 2; lithotomy on 7; not operated on, 8. This increases the number of adult patients with stone to 103, of which only 34 were lithotrized. From all I can learn it does not appear that lithotrity has since made much advance as an operation in London hospitals.

Sir William Fergusson, in his lectures delivered at the Royal College of Surgeons in 1864 and 1865 (since published), has given his enlarged experience in the practice of lithotrity. To that work I must refer those who wish to be well informed on all that refers to this operation; but what he wishes greatly to impress on

operators is the advantage of the removal of fragments by the aid of instruments. He says: "No doubt in most cases fragments come away spontaneously in a satisfactory manner, but even in many cases these would be rapidly expedited were such means taken." But he says the practice cannot be followed without instruments properly adapted for the purpose.

An important communication has been made relative to the statistics of lithotrity since this essay first appeared, in a paper read before the Royal Medical and Chirurgical Society, by Sir Henry Thompson, on May 10, 1870, of which the following is an abstract.[1]

The author presented a series of 184 consecutive cases of lithotrity in the adult, operated upon within a recent period; all treated by the same method and with the same instruments. He furnished all the most important details relating to each case, and presented the stone itself in almost every instance, preserved for inspection. His object was to make an impartial estimate of the crushing operation, to ascertain its real value, and its place amongst surgical operations. Although this had never yet been fully done, he regarded Sir B. Brodie's last communication to the Royal Medical and Chirurgical Society as perhaps the most trustworthy and valuable record, so far as it goes, which exists on the subject. In order to accomplish this object, he had made carefully written records of every case; and he cited the following circumstances as necessary to be taken into consideration; that the 184 cases had been treated by a uniform method, within a comparatively brief period of time; that all were adults, and embraced much variety of constitution; that all the important facts relative to each were noted in a history of each one, which was attached to the paper as an appendix; and that a large proportion of the calculi were of considerable size. And the author believed he was correct in saying that so complete an opportunity for studying the results of lithotrity had not been offered hitherto, since, as far as he was aware, the data necessary for the formation of a judgment had not been presented to the profession, either in this country or elsewhere.

The results of the operation were discussed under the following heads: 1st. The rate per cent. of recovery after the operation, and the causes of death when it occurred. 2d. The general condition of the patient after the operation. 3d. The frequency of recurrence of stone after lithotrity.

The chief facts relative to the 184 cases were as follows: that they were consecutive in point of time, no case being omitted; that all were adults, and mostly of advanced age; that they included many individuals of very feeble health and constitution; that they were chiefly British, although several were from other nations. The mean age of the 184 cases was no less than sixty-one years. The youngest was twenty-two years old. Only three were below thirty years. The oldest was 84 years. There were forty-six cases of seventy years and upwards. With very few exceptions, all stones of an ounce and upward were reserved for lithotomy. All obviously below that were crushed. Not one case was refused operation, not one was left unfinished, and in no instance was an operation of lithotrity completed by lithotomy. The recoveries, reckoning every kind of casualty following the operation, were 93 per cent.; but omitting five cases of death not by any means due to it, the mortality amounted to only 4 per cent. A second operation for recurrence of the stone was performed for 13 of the 184 cases; 122 were uric acid and the urates; 16 were mixed; 40 were phosphatic; 4 oxalate of lime; 1 cystic oxide; and 1 pure phosphate of lime.

The important logical conclusion to be derived from the mass of facts considered was, that lithotrity is an eminently successful operation. For a certain number of cases, its success may be regarded as a certainty—absolutely without fear of any contingency, except such as attends the minor operations of surgery—for example, the opening of a small abscess, or the passing of a catheter. For the author stated that he had never lost a patient in the whole course of his experience after crushing a stone which was no larger than a small nut; and this he considered was a size at which, with few exceptions, every stone ought to be discovered. But this very fact led the author to remark that the success of lithotrity cannot therefore be considered apart from a knowledge of the extent, in regard of the magnitude of the stone and the constitution of the patient, to which the capabilities of the operation have been pushed. When it is employed for stones as large as a date, or a small chestnut—and it is impossible to deny the excellent chance of success which this method offers to the subjects of such stones—a certain, but still only small, proportion of deaths must be expected. And the rate of mortality will correspond with augmentation in the size of the stone, and with the amount of existing disease and age on the part of the patient. Given a small stone in a fairly healthy person, and success is certain; the possibility of a fatal result in such a case depending only on the presence of those remote and excessively rare conditions which will make for an individual here and there the mere passing of a catheter a cause of death.

The rule observed had been, for the most part, to apply lithotrity to all calculi obviously less than an ounce in weight, easily discovered by sounding, and to operate on all larger ones by lithotomy.

Since this communication appeared, the number of Sir Henry Thompson's cases has reached 204, with one more death, making 13 deaths in the whole number.

[1] The paper is published *in extenso* in the Med.-Chir. Trans., vol. liii.

[Rapid Lithotrity with Evacuation.

(Litholapaxy of Bigelow.)

Rapid lithotrity is the fragmentation of calculous material in the bladder through the urethra, and immediate evacuation of the débris by aspiration, or by washing through a tube, with the express object in view of liberating the bladder as far as possible of all foreign material at a single sitting.

This operation was introduced to the profession by Bigelow, of Boston, and is called by him *litholapaxy*. The latter name, however, has not been generally accepted; and as the name Rapid Lithotrity serves very clearly to distinguish this operation from old-fashioned lithotrity, and has already been independently adopted by a number of surgeons, I think it may, with advantage, be retained.

Bigelow's first paper appeared in the American Journal of the Med. Sciences, January, 1878. A great number of short notices have since been published by a number of surgeons, describing one or more cases in detail, with remarks.

That rapid lithotrity is an assured success, and certain to hold its own among the great surgical manœuvres, has been amply demonstrated by the statistics of the operation since its general introduction not three years since.

The most recent attempt to gather statistical evidence of which I am aware, was published by myself, in a paper which was read before the Anatomical and Surgical Society, of Brooklyn, March 29, 1880;[1] and included cases reported before Feb. 15th, of the same year.

In a sum total of 120 operations at the hands of all operators, there were six deaths, one in twenty, exactly 5 per cent.

This is a remarkably good result, when it is considered that there were twenty-eight operators, and that the average age of the patients was about 55. The operations of my partner, Dr. Van Buren, and myself, in several of which Dr. L. A. Stimson did a large part of the work, now number thirty, with a single death—the average age of the patients being sixty. The statistical showing moreover becomes better when the results obtained by operators, who may be presumed to be reasonably adroit, are taken apart from those obtained by general surgeons, not especially skilled in urethral and vesical matters. So far as I have been able to collect statistics of cases published, and those personally known to me at this date (Nov. 1st, 1880), I find one hundred and sixty-two cases: I divide these into two classes, (1) patients operated upon by surgeons who have recorded five or more operations, and who thus may be presumed to have had fair opportunities in the line of genito-urinary surgery; and (2) patients operated upon by surgeons who have done less than five operations, who presumably have not had such opportunities. Of the former there are 125 operations and five deaths, a mortality of only 4 per cent., one in twenty-five; while of the latter, I find 37 operations and 6 deaths, a mortality of about one in six, about 16 per cent. How striking a comment upon the statement so often repeated that this operation is, after all, a serious one in inexperienced hands. The beginner will be wiser to operate first by the old method of slow lithotrity, upon a small stone, without ether. When his powers are thus developed, he will be ripe for the rapid operation, and justified in undertaking it.

It is rather strange that an improvement in lithotrity should have appeared just as the general confidence of the profession in the wide applicability of the operation was beginning to be shaken, and still more odd, that this advance should be an attempt to do exactly what the earliest lithotritists tried to do, but their more experienced successors abandoned.

In March, 1878, three months after the appearance of Bigelow's paper in America, in a discussion following an admirable essay by Thompson, before the Royal Medico-Chirurgical Society, in London,[1] the general conclusion of some of the best surgeons of England seemed to be, that nothing more need be expected from lithotrity, that perhaps even it had been pushed too far, and that in future probably it would be better to crush less and cut more.

Thompson, even before this time, had advocated crushings at shorter intervals, occasionally with ether, and was making more use of Clover's washing bottle than formerly. He had also plainly given up the old fashioned notion, that in case of cystitis following lithotrity, the patient must be left at rest, and dosed until his

[1 Annals of the Anatomical and Surgical Soc., vol. ii., 6, 1880.]

[1 Lancet, March 16, 1878, p. 385.]

cystitis subsided before he could be crushed again. On the contrary, recognizing the sharp fragments as sufficient cause for a continuance of cystitis, he advocated in these cases another sitting of lithotrity at a short interval as a proper treatment of the cystitis, ether to be used, and as much as possible of the foreign matter to be removed from the bladder. Had Thompson generalized a little further and adopted complete fragmentation of the stone, and entire evacuation at the time of the first operation as the proper course in all cases where lithotrity was applicable, he would have invented rapid lithotrity, the litholapaxy of Bigelow.

The honor, however, of generalizing the process and constructing an operation totally new in its design, certainly belongs to Prof. Bigelow.

Although Heurteloup, in 1847,[1] claimed habitually to remove calculi at a single sitting, and only admitted three deaths in sixty-nine cases; and although Leroy d' Etiolles, at a meeting of the Académie des Sciences, April 27th, 1846,[2] claimed that he could extract from the bladder at a single sitting a stone one and one-third inch in diameter, and boasted that he had been successful in the immediate extraction of stone in more than a hundred cases; and although Mercier's washing bottle, as pictured in his Traitement préservatif et curatif des sédiments, etc., Paris, 1872, page 373, is as nearly as possible a counterpart of Bigelow's first washer; yet there is no reason to be found in any of the writings or actions of any surgeon before Bigelow to justify the conclusion that the modern operation was even thought of, namely, entire fragmentation and entire removal by aspiration of a stone from a healthy bladder.

The reason why the idea of entire removal of a stone at a single sitting was given up by early operators, was because too much damage was done to the bladder and urethra in rude efforts at the extraction of débris by inefficient apparatus. Civiale made his sittings shorter and shorter the longer he operated, and Thompson was only beginning to lengthen his sittings and shorten the interval when Bigelow ripened his discovery and announced it to the world.

The varied machinery for washing the bladder, moreover, devised from time to time by Leroy d' Etiolles, Cornay, Mercier, Nélaton, Maisonneuve, Clover, Coxeter, and others were avowedly designed not to assist the operation so much as to make it possible in cases of atonied bladder. The function of the instruments was to replace the detrusor urinæ where its power failed, and they were not intended for use in the healthy bladder. Modern rapid lithotrity aims at a mechanical evacuation of fragmented material from the bladder by aspiration, and is indifferent as to the tonic or atonic condition of the vesical walls.

Cases in which rapid lithotrity is applicable.—In discussing the merits of rapid lithotrity in a former paper,[1] I think I have shown that no condition of disease of the urinary organs which would not contra-indicate an operation elsewhere is sufficient to cause a surgeon to deny rapid lithotrity to his patient. Very advanced age might make the advisability of any operation doubtful, and advanced pyelitis makes rapid lithotrity hazardous, but no other condition makes it unadvisable which would not equally well contra-indicate any surgical operation involving more or less shock, and etherization for half an hour or more. I have operated upon patients in advanced life, suffering from great general debility, moderate pyelitis, Bright's disease, probable kidney-stone, chronic bronchitis, very extensive valvular heart-disease, sub-acute orchitis, stricture, and various grades of chronic inflammation of the bladder, without having the success of the operation in any way compromised by these complications.

Enlarged prostate and stricture of the urethra form no obstacle to the operation, provided, in prostatic disease, an evacuating tube of moderate size may be made to enter the bladder without force. If stricture be tight it should be enlarged by dilatation or any suitable operation as a preparatory step to the removal of the stone. When tight organic stricture of the deep urethra complicates stone, it is probable that external perineal urethrotomy, combined with lithotomy or with crushing and evacuation, through the wound, will often be more applicable than any other surgical procedure, as this treats the stricture effectively as well as the stone.

The stone itself is unfit for rapid lithotrity only when it is too large and hard to be caught and broken by the lithotrite, or when the nucleus is some foreign body which in itself is unsuitable for extraction by this method: glass, iron, sometimes bone, wood, or other substance. A large soft stone, even if it is too large to be grasped in the bite of the lithotrite, may yet be successfully attacked under ether, and multiple stone is of all others the easiest to manage relatively to the amount of material to be extracted.

Preparation of the patient.—It is per-

[1 De la Lithotripsie sans fragments, etc., Labbé, Paris, 1847.]

[2 Comptes-rendus, 1846, i., p. 704.]

[1 Rapid Lithotrity with Evacuation," Am. Journ. of Med. Sci., April, 1880.]

haps better in all cases that the patient should have rest for a few days in bed just before his operation, but this is not at all essential to success. When the urine is bright and clear the only medication necessary is to render it abundant and faintly alkaline by the use of a little citrate of potash and Bethesda water for about twenty-four hours before the operation.

When the urine is putrid, or ammoniacal and full of pus and stringy mucus, it is decidedly better, if there is time, that the patient should be prepared for his operation by having the bladder washed out, while he is lying up in bed, with a solution of borax in hot water, almost a teaspoonful to the pint, and should take Bethesda, Poland, Buffalo Lithia, or any other diluent mineral water or drink, until the bladder has been sweetened.

The urethra should be examined with reference to its capacity to receive a full-sized washing tube, and the passage of a full-sized steel sound a few times at intervals of several days can result only in good.

On the day of the operation the lower bowel should be emptied, ten grains of quinine administered two or three hours before ether is given, and ten minims of Magendie's solution of morphia about ten minutes before commencing the ether —in most cases.

These precautions are wiser but not essential to success, as many successful cases have proved.

The instruments with which this operation is performed are simply a lithotrite, a washing tube, and a washing bottle. There are a number of varieties of each of these instruments in the shops. Any lithotrite will do, but it is decidedly better for rapid work that the instrument shall be one which will not clog under any circumstances, is quite strong, and will not readily catch the folds of the bladder, of which there is some danger when the patient is under the influence of ether. With Bigelow's latest instrument, and with a variety I commonly use myself, a fenestrated instrument slightly modified from the older patterns, I find no difficulty in picking up a fold of the bladder upon the dead subject, and but little more trouble in doing the same upon the living bladder. I think this may be done with any instrument, and I believe that an instrument is perfectly good if it is only with a little difficulty that the bladder can be caught in its blades. I do hold, however, that no man is fit to operate upon an etherized patient unless he is confident that he is able to detect the fact at once should he catch a fold of mucous membrane in his instrument, and able to drop it without inflicting any damage upon the bladder.

There are several new instruments in England which rapid lithotrity has called out. Thompson's present lithotrite is stronger than his old type. It is non-fenestrated; the male blade is considerably smaller than the female, and is provided with a strong spur at the heel. This enables the instrument to clear itself, prevents clogging, etc.

Bigelow's lithotrite (fig. 485) has several new features. The customary wheel in

Fig. 485.

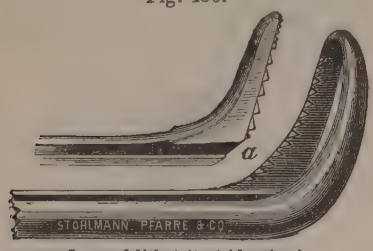
Bigelow's lithotrite.

the handle is replaced by a solid ball, *a*. The lock is a nice piece of mechanism at *b* and *c*. The instrument is non-fenestrated, and provided with a strong spur, *e*, which passes through the fenestra, *f*. It is said not to clog. The stopcock at *d*

has been omitted in the latest instruments, and a peculiar S-shape has been given to the toe of the shoe of the female blade, which is said greatly to facilitate the introduction of the instrument.

The instrument I use is fenestrated, made much stronger than former patterns, and provided with a wheel at the handle

Fig. 486.



Jaws of lithotrite (side view).

larger than that of old instruments, and a very prominent button which allows the

Fig. 487.

Jaws of lithotrite (end view).

screw power to be thrown on by any finger of either hand in any position of the instrument. This lithotrite cannot clog by any conceivable possibility. The width of the shoulder at *a* makes it as strong as it is possible for its size. The truth is that any good instrument will do the work in the hands of a good operator without doing damage to the patient. This is demonstrated by the fact that the three operators who have respectively reported the greatest number of cases, Thompson, Bigelow, and Van Buren and Keyes, have each used a different lithotrite and have each had one death.

The tubes used vary from a simple large-eyed catheter up to tubes of large size, specially intended for use in this operation. Quite a number of varieties of the latter have sprung up. Bigelow's tubes, straight and curved, certainly do very efficient service. Thompson uses a blunter tube, and Warren, of Boston, has adapted a spiral tip (fig. 488) to Bigelow's tubes, which he believes renders their introduction easier.

The washing-bottle is simply a ball-syringe without valves, and having a receptacle for débris. Bigelow has devised several, Thompson two, Berkeley Hill one. Clover's, Mercier's, Cornay's, Crampton's, and several others would answer in case of need.

Only two require description, Bigelow's latest and Thompson's.

Bigelow's washer (fig. 489) is very complete and free from the faults of his first washer. It is represented coupled for use. The stand B holds the bag by its glass receiver A. The rubber bulb C is furnished with an air-valve at the top to prevent the entrance into the bladder of

Fig. 488.

Lithotrity tubes with Warren's spiral tip.

any air which may have entered the bulb. The extra tube H, through the stopcock G, regulates the amount of fluid in the bladder, diminishing or increasing the pressure at will, without calling for any change in the position of the instrument. The water passes in and out of the bladder through the large tube D. The two stopcocks at F are to prevent the entrance of air into the tubes during the coupling process.

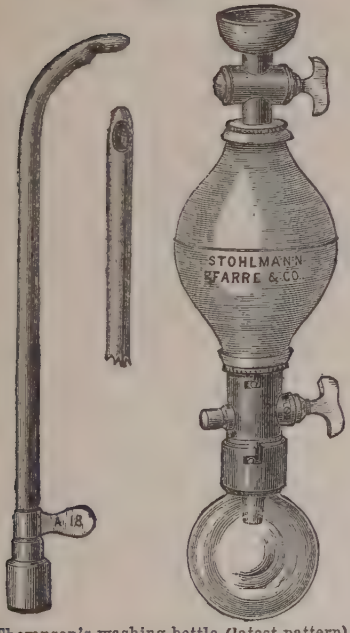
Thompson's bottle is simpler. His latest model is shown at fig. 490. It explains itself. Personally I prefer, and always use, the first washing bottle devised by Thompson (fig. 491). I think the stopcock works to better advantage, and the receiver is better. A sphere does not allow the operator to see the fragments fall after the wash gets tinged with blood.

The operation.—It is better to move the patient to a high, narrow table, after he is fully anæsthetized, and to place him comfortably upon his back, with the hips elevated and the thighs apart. Two assistants are absolutely necessary—one for the ether, and one to fill and empty the washer while the operator is crushing the stone. It is better to have three

Fig. 489.

Bigelow's washer, coupled for use.

Fig. 490.



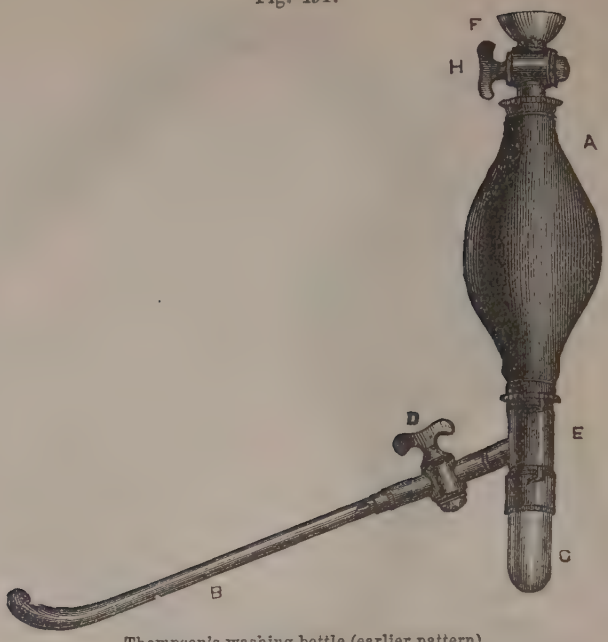
Thompson's washing bottle (latest pattern).

assistants, or even four, so that the thighs may be held apart should the patient take the ether badly.

The urethra should now be tested with a full-sized steel sound, so as to decide how large a tube may be used. The larger the tube, the shorter the operation will be; and if several sizes can be gained by incising the meatus, as is often the case, this little operation should be performed as a first step.

As large a tube should be used as will pass without force; all violence is to be shunned. In the essay I have already referred to, I think I clearly proved that injury done to the deep urethra was a much more serious matter than injury done to the bladder, therefore the urethra should be respected, and only moderate-sized tubes and instruments employed. Most of Thompson's work has been done with a tube not larger than 26 or 27 (French), and in only a few of my operations have I gone above that size. One of my patients—a case of encysted stone constantly complicated with secondary phosphatic deposits, which require extraction two or three times a year—this man, although suffering from prostatic disease, and with kidneys of doubtful soundness, never has had serious trouble from his washing operations when a 26 (French) tube was used; although in one early operation with crushing, the mucous membrane of the bladder was injured with a defective lithotrite. Becoming

Fig. 491.



Thompson's washing bottle (earlier pattern).

despondent at his relapses, this patient applied to another surgeon. The latter used a straight tube, No. 30 (French). As a consequence the patient passed blood in his urine for many days, and had such an attack of cystitis as he had not had before, nor has had since. At one time, indeed, during about a week, it was a close struggle between life and death. He recovered, however, had his phosphatic relapses as usual, and I have washed him out several times since with 26 (French). Each operation gives him great temporary relief, and is not attended by any bad symptoms. He declines to be cut for his encysted stone.

Having decided then upon the largest size which the urethra will receive without violence, it is well to introduce the tube, draw off the urine through it, and wash the bladder with a disinfecting solution. I prefer a solution of borax in hot water; and use it at all strengths, from a heaping teaspoonful to the pint up to a saturated solution (about one drachm to the ounce), according to the degree of putridity or ammoniacal change in the urine. Several portions of fluid may be used until the wash returns from the bladder sweet and clean. When this result is reached, a few ounces of fluid may be left in the bladder and the crushing proceeded with.

A word is necessary here as to the manner of using the washing bottle.

Bigelow's new washer makes it possible to suck air out of the bladder and replace it with water without removing the tube; an enormous advantage over his first washer; and the various stopcocks in the coupling render it quite easy to avoid getting air into the bladder on first introducing the tube. Thompson's washer, however, which I greatly prefer on account of its simplicity, requires a little care in order that air be not introduced into the bladder when the tube is first put in. To avoid this, it is only necessary to act as follows:—

I introduce the tube and draw off the urine. Then withdraw the tube until its eye is in the prostatic sinus. Now couple on the bottle and turn the cock. The air in the tube will spontaneously mount into the bottle, being displaced by the water, and will remain in the air-trap above. On subsequent introductions of the tube, this manœuvre may be practised at any moment after the eye of the tube is within the urethra, and before it has reached the bladder. In this way air may be absolutely excluded from the bladder. Its presence is a great hindrance to thorough washing. Should it enter it may be sucked out by aspiration; but it is difficult to get out the last few bubbles, especially in case the bladder is atonied; and the churning of the froth mars the beauty and the success of the washing more or less according to its extent.

The crushing is effected as in ordinary lithotrity, with the exception that the object is to fragment as much and pulverize as little as possible, since pulverization

beyond the point at which the fragments will pass the tube is unnecessary.

The lithotrite should be used with as much gentleness as possible, for although the patience of the bladder under rough handling and its great tolerance have been amply tested, yet it is not well to put the patient organ to a test if it can be avoided. Bigelow counsels the greatest care, and emphasizes the fact that rapid lithotrity is an operation which should be done slowly—in so far as slowness of manipulation may be essential in the exercise of care not to injure the bladder or urethra.

A number of seizures of the stone may be made in succession, as many as one chooses if he has an instrument which will not clog; but generally from six to a dozen is enough, for all those seizures are useless, and a loss of time in which fragments small enough to have passed the tube are caught and crushed.

When a certain number of fragments have been made a tube is introduced, the bottle attached, and the bladder injected and aspirated a number of times in succession, the same warm water rushing back and forth through the tube, carrying with it such fragments as will pass the tube and allowing them to collect in the glass receiver at the bottom of the bulb.

As soon as fragments cease to fall freely into the glass receiver, the tube should be withdrawn and the washer handed to an assistant while the operator immediately re-introduces the lithothrite. By the time a proper number of seizures has again been made, the assistant has refilled the bottle, and thus either the tube or the lithotrite is constantly in the bladder until all the foreign material has been removed, unless proper cause exists for arresting the operation and leaving a portion of stone in the bladder for removal at a second sitting.

Last fragments may be detected as a rule in the bladder (when no air has entered its cavity) by placing the ear over the lower part of the abdomen while the tube is in the bladder and the water is being forced in and out of its cavity by the alternate compression and relaxation of the bulb. The swash of the water is very distinctly heard through the abdominal walls, and any remaining piece or pieces of stone will be stirred up in the current and manifest their presence by a sharp click against the tube. Indeed, this method of sounding for a small stone or a fragment is successful sometimes where the searcher only affords negative evidence, failing to touch the foreign body.

Sometimes the last fragment is caught with ease very promptly. Should it fail to be entrapped in two or three washings, and fail to be caught readily in the lithotrite, it is better not to prolong the sitting over-much in attempts to catch it. A single small fragment will not prevent the patient from rallying promptly from his operation, and may be easily caught, crushed, and washed out at a second sitting a week or more after the first, when the bladder is in good condition. This reasoning applies with great force in the case of an old atonied bladder. In such a bladder a small fragment which may later easily pass by the urethra will sometimes elude the suction force for a considerable time, and finally be given up in despair, only to pass a few days later with great ease during one of the patient's voluntary efforts.

The amount of time which one may safely give to a single sitting of lithotrity has not been absolutely fixed. Bigelow believes that the element time may be wholly disregarded, and that the operation should only terminate, as a rule, when all the stone has been removed. He has expended three and three-quarter hours in a single sitting under ether, and his patient did perfectly well. Thompson, who has operated more often than any one else, has gradually extended the amount of time he is willing to allow to a single sitting up to about half an hour. My limit, to which I do not feel at all bound, however, has been one hour, since etherization for an entire hour is in itself something of a shock for the patient, and because there are few stones encountered which an ordinarily expert operator with a good instrument could not remove in that time. I have only twice extended any operation of mine beyond the limits of an hour. Both were cases of old men with large stones (630 and 495 grains.) Both recovered promptly and perfectly.

The amount of yield to be expected from a given number of minutes' work, depends upon so many different circumstances that an average is hard to be reached. I have computed[1] that a yield of five grains of dried stone to the minute—300 grains an hour—is all that need be expected. Thompson, whose manipulative powers are wonderful, has reached a higher average.

But perhaps it is unwise to have any expectations on this subject, or to make any effort, since thereby the operation may be spoiled, as haste and flurry are certain to spoil it.

My own experience shows me the enormous difference of yield obtained under different circumstances. In my eighteenth case, after I was entirely familiar with

[1 Loc. cit.]

the operation, hard work during an entire hour only yielded me thirty grains of dried stone, while in my twenty-third case the yield in forty-five minutes was 765 grains. The case was one of single phosphatic stone in a healthy bladder, there being no prostatic disease.

After treatment.—The bladder is finally washed clean and left empty, and the patient put to bed and warmed with hot bottles. He is furnished with what anodyne he may require, and plenty of Bethesda water or such other bland diluent as may have been found to act well. A milk diet, or something near it, is instituted for a few days. The quinine may be kept up at gr. x—xv a day. The bowels are to be moved by a cathartic upon the third day, and a catheter is used appropriately should retention occur; it should always be anticipated as a possibility.

If the patient has atony, or his urine remains or becomes offensive, the bladder should be irrigated once or twice a day with a solution of borax in water, about a teaspoonful to the pint.

All complications are to be met according to general rules.

In all ordinary cases the patient may be expected to be up, and even out, in a week. Chill, fever, etc., after this operation are far less common than might be expected; but they do occur to a moderate extent in at least one half the cases. I have never had epididymitis or prolonged cystitis follow an operation, and believe these complications to be very uncommon.]

DISEASES OF THE MALE ORGANS OF GENERATION.

By George Murray Humphry, Esq.

Revised by J. William White, M.D.

Failures in Development of the Testicle.

There are two peculiarities in the development of the testicle which deserve notice here, forasmuch as they are related to certain peculiarities in the pathology of the organ. *First.* Each testicle is formed from two distinct parts. The *body* of the gland is produced from primitive fœtal structure in front of, but apparently independent of, the Wolffian body, or temporary kidney, which lies along the hinder wall of the abdomen; whereas the *epididymis* is evolved from the lower part of the Wolffian body itself, and from the duct of that body, the vas deferens being the continuation of the Wolffian duct of the lower and hinder part of the bladder.[1] Reminiscences of this mode of development are furnished by the vessels which supply the two parts. The spermatic artery, derived from the aorta a little below the renal arteries, is distributed chiefly to the body of the testicle; and the deferential artery, from the hypogastric, is distributed to the vas deferens and part of the epididymis, the remainder of the epididymis being supplied by the anastomosing branch between the spermatic and the deferential arteries. The close sympathy also of the epididymis with the several parts of the urinary apparatus, particularly with the prostatic part, evinced in the frequent excitation of inflammation in it by irritation in the urethra, bladder, or kidney, and the manner in which that inflammation is commonly confined to it, without spreading to the body of the testicle, are probably, in some measure, due to the mode of development of the organ.

The *second* peculiarity is the change of position from the lumbar region to the scrotum, which takes place gradually during the fœtal state, and is usually accomplished before birth. The physiological purpose of this change of position, and the means by which it is effected, are not quite clear. Viewing it in a pathological light, we feel that had the testicle been retained in the abdomen, and possessed the same sympathies and liabilities to disease which it now has, it would have proved a troublesome companion to the other viscera. At the same time it would have been less exposed to injury, and the many maladies consequent on its passage through the abdominal wall would have

[1] Kölliker, Entwickelungsgeschichte des Menschen und der höheren Thiere, p. 443.

been spared. We must not forget that the covering of peritoneum which it acquires in its course is a considerable protection against injury and against the extension to it of disease from the skin and superficial structures of the scrotum.

The question of *supernumerary testicles* may be dismissed with the statement that there is no clear evidence of one having ever been met with. The claimant to this distinction has in each case, when it has been submitted to dissection or to careful examination, proved to be either a cyst or a fatty or fibrous tumor in the cord or in some part of the scrotum, or a piece of omentum.[1]

[St. Hilaire, quoted by Curling, has described a case said to be unique, of union of both testicles in the abdomen. The individual, who was supposed to be a girl, died at the age of eighteen months. There was complete hypospadias, the scrotum was bifid and empty, and the kidneys and testicles were joined together in the median line.]

Imperfect development.—In some few instances there has been complete *absence* of one or of both testicles, accompanied occasionally, but not always, by more or less deficiency of the other parts of the generative apparatus. It is remarkable that the vas deferens and vesicula seminalis should be present and grow when the testicle is absent; and it is still more remarkable that in some cases of deficient testicle, the vas deferens of natural size, or nearly so, has been traced into and through the inguinal canal.[2]

The cases in which the vas deferens has been found deficient in some part of its course are more numerous. The deficiency occurs most frequently near the testicle, occcasionally near the bladder, and more rarely in its whole length. In some of these cases the epididymis has been also absent; but in others it was present, and was, like the testicle, as large as usual. These varieties do not admit of precise explanation in the present state of our knowledge of the mode of development of the organs; but they show that the development and growth of the several parts of the genital apparatus may go on independently of one another, however essential each may be to the function of the others. Both testicle and vesicula seminalis may be well formed, and may continue to be well nourished, though entirely useless, from the want of a vas deferens to connect the one with the other; so that the plumpness of a testicle and its descent into the scrotum are no certain indications of the performance of its function being possible.[1]

The independent growth and secretion of the vesiculæ seminales explains the fact, that the person in whom the testes are absent or wasted may possess virile power, though of course he will be sterile.

A man, aged forty-four, whose scrotum is small and the testes can scarcely be said to exist, the vas deferens on either side terminating in a small firmish lump, which appears to be a diminutive epididymis, and which is very tender, tells me that he has by no means a want of sexual propensity or power; on the contrary, he was very dissipated before marriage, and indulged every night for the first three years afterwards; but never had children. To the best of his belief, the testes have been in their present condition from birth; at least, he never knew them to be otherwise. When he was eight years old, disease, probably gonorrhœa, was communicated to him by a maid-servant, who was transported for seven years for the offence. Whether this had any effect upon the organs he cannot tell. He has beard and moustache, and presents no indications of want of virility. A man with testicles in a similar condition, from birth, was lately a patient at Addenbrooke's Hospital. He stated that his wife had children.[2]

A gentleman, from whom both testicles had been removed, informed me that the operation had caused no difference in his sexual inclination and power. I should add, however, that another patient similarly circumstanced told me that he was impotent soon after the loss of the organs.

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[1] Cases of supernumerary testicle are recorded in the Lancet, 1865, pp. 448, 473, 501. There was, however, no proof beyond that of external examination in any of the cases.

[2] Case and résumé of cases by Mr. Paget, Med. Gazette, vol. xxix., p. 817; also Curling, Diseases of the Testis, 1856, p. 3. Ernest Godard has investigated the subject of deficiency of the testicle and seminal apparatus with greater assiduity than any other person. Recherches sur les monorchides et les cryptorchides chez l'homme, Paris, 1856; Études sur la monorchidie et la cryptorchidie chez l'homme, Paris, 1857; Études sur l'absence congéniale du testicule, Paris, 1859; Mémoires de la Société de Biologie, 1856, p. 216; 1857, p. 382; 1859, vol. i., p. 311 and p. 327. See also Royers, Des oblitérations des voies spermatiques, in Canstatt's Jahresbericht, 1858, vol. iii., p. 383.

[1] The experiments on animals by Sir A. Cooper, On the Testis, p. 51; Mr. Curling, Diseases of the Testis, p. 11; and M. Gosselin, Archives générales de Médecine, Sept., 1853, indicate that the division of the vas deferens has little or no influence upon the nutrition of the testicle; and atrophy or removal of a testicle is not usually followed by wasting of the corresponding vesicula seminalis.

[2] See case of apparently undeveloped testes retained in the groin; the man's wife had

Retention of testicle.—The descent of the testicle is delayed till a few months, or a year, after birth, in about one infant in five. It may take place later. Sir A. Cooper has "many times seen the testes descending from thirteen to seventeen years, probably from new excitement at that period; and the descent is in some cases not accomplished till twenty-one." [If the descent does not take place before puberty, it very seldom occurs later in life.] Under these circumstances the testicle is liable to be accompanied or followed by a portion of intestine, forming a "congenital hernia," and not unfrequently the bowel is adherent to the gland.[1] In about one person in a thousand one of the testicles (the right or the left in a nearly equal proportion of cases) is permanently retained in the abdominal cavity or in the inguinal canal or the groin. In a few instances this happens with both testicles. The cause of the failure is probably, in most cases, a deficiency in the force, whether it be the contraction of the fibres of the gubernaculum or some other, by which the descent of the gland is effected. Sometimes there has been an impediment to the process, either narrowness of one of the inguinal rings, or an obstacle in the inguinal canal, or adhesions to some of the viscera or to the abdominal wall, consequent on intra-uterine peritonitis, or an imperfect development of the "mesorchium." Shortness of the vas deferens or other vessels may also be mentioned among the causes of failure of descent of the testicle; though in several instances they have been shown by dissection to be tortuously disposed.[1]

The *condition of the imperfectly descended testicle* has been a matter of anxious inquiry. It has, in a few instances, been found of full size;[2] but, as a general rule, it is imperfectly formed, or smaller than natural, its glandular tissues retaining the immature characters of the infantile organ; or it may be atrophied, in a state of fibrous or fatty degeneration, and presenting scarcely any trace of glandular structure.[3] This may be in consequence of the position being less favorable than the scrotum is to its nutrition.[4] Whether that be the cause or not, the relation between imperfection of development and incomplete passage to the scrotum is frequently to be observed. Although, therefore, it is quite possible, in any case, that the retained testicle may perform its functions, yet there must always be great suspicion of its inefficiency. Where the other testicle has descended and is natural, this is of little consequence, one testicle being quite sufficient for generative purposes; but where both testicles are retained, the virility must be a matter of anxiety and much uncertainty. Proofs, however, are not wanting that impotence is no necessary result of this condition.[5]

family: Path. Trans., vol. xix., p. 288. M. Liégeois (Med. Times and Gaz., 1869, vol. ii., p. 247) has made many observations, and believes that all healthy persons, even octogenarians, carry in their semen the material elements of fecundation. Chronic diseases, as phthisis, are attended with a diminution of spermatozoa. Cryptorchids, however, are sterile, although their stature, physical powers, and moral faculties may be developed, as in other men. The same author (Med. Times and Gazette, Nov. 6, 1869) gives two observations of imperfect development of the testes from Curling and Laborde, in both of which spermatozoa were absent, and states that he has examined the seminal fluid of six persons who presented an atrophy of one of the testicles, and found a diminution of spermatozoa, as well as of the virile faculties in each.

[1] That hernia is not always an attendant on late descent of the testicle is proved by Malgaigne's case of a boy aged thirteen, whose left testicle suddenly descended into the groin in consequence of a fall, and was not followed by rupture (Anat. chirurg., vol. ii., p. 266). I was lately consulted, for inflammation of the bladder, by a patient aged sixty, both of whose testicles were retained and did not pass the external ring till he was forty. The protrusion was regarded as rupture, and its further progress prevented by a double truss. He married a woman older than himself when he was thirty, but never effected an entrance, because the emissions took place too soon.

[1] In each of three specimens of undescended testes in Guy's Museum, a peritoneal pouch occupies and projects a little beyond the inguinal canal, and there appears nothing in the canal to prevent the descent. The cause of its failure is not apparent in any of the cases. The testicle in each is rather small.

[2] Cloquet, Sur les Hernies abd. Cooper, On the Testis; in this patient, who committed suicide, the gland was *nearly* of the natural size.

[3] Brit. Med. Journal, 1859, p. 110; report of discussion at Med.-Chir. Soc., Curling, p. 27; and Brit. and For. Med.-Chir. Rev., April, 1864.

[4] This view is supported by the instances in which the testicle has been retained in the abdomen by adhesions, and yet has been stunted in its development or growth; Trans. of Path. Soc., vol. viii., p. 265; also by the case of a Parisian mentioned in Med. Times and Gaz., vol. xviii., p. 67, whose right testicle was suddenly and violently drawn up into the inguinal canal during masturbation when he was young, and never reappeared. The body of the testicle was found much atrophied, soft, and pulpy, and but one-fifth of the size of its fellow.

[5] Hunter's Works, by Palmer, vol. iv., p.

Some opinion may be formed by the presence or absence of those external indications and those propensities which are usual attendants upon virility. These, however, are not quite to be relied on as evidence of the power of impregnating the female; for in some cases of the kind there have been virility and seminal emissions, during connection and at other times, although there were no spermatozoa in the fluid and no power of impregnation.[1]

Diseases of retained testicle.—The recorded instances of disease in the testicle when retained in the abdomen are few. In a case related by Dr. G. Johnson,[2] it was the seat of malignant disease. When in the inguinal canal it is as liable to inflammation from gonorrhœa as when it is in the scrotum; and the pain is more severe, in consequence of the confined position of the gland, and the pressure of the abdominal muscles upon it. In this situation it has been the seat of malignant disease;[3] and it also sometimes suffers from the pressure of the muscles, especially about the time of puberty, or from being displaced by a sudden strain, and forced into a narrow part of the canal. In some instances of this last kind such repeated attacks of inflammation ensued as to necessitate the removal of the gland.[1] [The palliative treatment should consist of leeches, cold or hot fomentations, according to the sensations of the patient, and general antiphlogistic remedies.] The symptoms, under these circumstances, have been so violent as to be mistaken for hernia,[2] and have even led to an operation upon the tumor.[3] A correct diagnosis in such a case must be difficult, sometimes impossible. The surgeon must be guided by the general symptoms. [The empty scrotum, the shape of the tumor, its resistance to pressure, and the characteristic nauseating sensation produced by the latter, are valuable diagnostic points. If the hernia be strangulated, the persistent and stercoraceous vomiting would be pathognomonic.] If, after the employment of the ordinary remedies, they continue to indicate strangulation of intestine, he should not hesitate to cut down upon the swelling, and ascertain the real nature of its contents. A testicle retained behind the abdominal ring in the inguinal canal, and inflamed, may be mistaken for bubo, the accompanying blush in the skin suggesting that suppuration has taken place. Ricord was nearly deceived by a case of the sort.[4] Sir A. Cooper observes, "it often happens that when a testis remains in the inguinal canal, there are severe spasms of the cremaster or muscles of that canal, accompanied with violent pain, and only relieved by the hot bath and by fomentation."

In a few cases the testicle retained in the inguinal canal has been the subject of hydrocele, constituting what has been called by Mr. Curling an inguinal hydrocele. The diagnosis in such a case would be based upon the transparency of the swelling, and the absence of the testicle from its normal position; and the treatment, whether palliative or radical, must be determined by the circumstances. Unless it were a source of much inconvenience, non-interference would be the most judicious course.[5]

18; Curling, p. 26; Brit. Med. Journ., 1859, p. 110; Poland, Guy's Hosp. Reports, 2d series, vol. i., p. 162. Mr. Coulson stated at the Med.-Chir. Soc., Jan. 11, 1859, that he was "consulted in a case in which neither testicle had descended into the scrotum, one being in the inguinal canal and the other in the abdomen. This gentleman married, and was able to perform his marital duties."

[1] Med. Times and Gaz. vol. xx., p. 101; Trans. of Path. Soc., vol. xi., 160. Godard, "Études sur l'absence congéniale du testicule," entertains the view that a testicle which is arrested in its passage to the scrotum never secretes spermatozoa or fluid capable of impregnating the female. In a paper on sterility in man, with cases, read before the Med.-Chir. Soc., June 23, 1863, Mr. Curling observes that "spermatozoa have not been discovered after death in the spermatic rings (ducts) of a detained testicle in any one instance that he knows of." See Path. Trans., vol. xii. p. 143. Cryptorchids may be, and sometimes are, *virile;* but the facts which he has collected indicate that they are *sterile;* and he is inclined to call in question the claims to paternity which have been advanced in some of these cases. He speaks also of the effects of gonorrhœal epididymitis, tubercular deposits in the epididymis, and stricture of the urethra, in causing sterility. See also Brit. and For. Med.-Chir. Review, April, 1864.

[2] Med.-Chir. Trans., vol. xlii., p. 15.

[3] Mr. Arnott gives a case of this in Med.-Chir. Trans., vol. xxx., p. 9, and quotes others. Virchow, Die krankhaften Geschwülste, remarks that the frequency of malignant disease in the testicle retained in this situation is due partly to the injuries to which it is subjected by the contractions of the abdominal muscles, and partly to predisposition associated with its imperfect development. See also Med. Times and Gaz., Feb. 15, 1868, p. 176; St. George's Hospital Reports, vol. ii.

[1] Dublin Journal of Medical Science, vol. xxvi., p. 257; Medical Times and Gazette, vol. xix., p. 379.

[2] Richter, in Lawrence On Hernia, 5th ed., p. 571; Pott's Treatise on Ruptures, p. 352.

[4] Prov. Med. Journal, vol. vi., p. 264.

[5] In Trans. of Path. Society, vol. ix., p. 316, is the dissection of a large hydrocele in

[3] Delasiauve, Revue médicale, 1840.

Complication with hernia.—Retained testicle is sometimes complicated with hernia, which may pass beyond the testicle through the inguinal canal, and being unable to descend into the imperfectly-developed scrotum, may rise towards the ilium. The hernia is contained in the same peritoneal pouch as the testicle; and the complication may be embarrassing, from the testicle being unable to bear the pressure of the truss requisite to prevent the descent of the hernia. In the case of a lad, aged nineteen, the suffering from the compression of the gland was so severe that Mr. Solly removed the organ.[1] [Monod and Terrillon, in an article on inguinal castration (Archives générales de médicine, Nos. 2 and 3, 1880), arrive at the following conclusions: 1. Inguinal castration is not a dangerous operation, and in a large majority of cases the patient recovers. 2. Peritonitis is not, as has been maintained, an inevitable and constantly fatal consequence of the operation. It is indeed an unfrequent result. It was observed in but three of fifty cases, and in only one of these was it fatal. 3. The indications for inguinal castration need not sensibly differ from those for scrotal castration. 4. In cases of tumors the operation may be practised with less hesitation, since degeneration of the misplaced gland is most frequently of a cancerous nature, and the inguinal testicle is in all cases incapable of generative functions. 5. The operation could, and indeed should, be performed at an early period, with the hope of preventing a relapse, which hitherto has been of almost constant occurrence. 6. Inguinal castration is indicated when the misplaced testicle is painful, or when it is the seat of serious or repeated inflammatory affections (pseudo-strangulation). The inutility of the organ with regard to its function, is a point in favor of intervention. 7. The operation is an easy one, and does not, as a rule, need the employment of any special proceeding.]

If a portion of bowel accompanies the testicle, it should be replaced, the testicle being left in the scrotum, and a truss applied between the two. Should the bowel, however, be adherent to the testicle, so that either the latter must be kept in the abdomen or the patient remain the subject of hernia, the former alternative is to be preferred, and the descent of both testicle and hernia must be prevented by a truss. It has now and then happened that a portion of bowel has descended into the scrotum, instead of the testicle. In such a case, if it be an infant, I think it better to leave the case alone for a time, in the hope that the testicle may descend, and that it may be possible to return and retain the hernia by a truss, while the testicle remains in the scrotum. Should, however, the testicle not descend, the hernia must be treated by a truss, and both it and the testicle be kept in the abdomen.

We know no means of determining or accelerating the descent of the testicle. Attempts have been made by operation to withdraw the gland from the inguinal canal and place it in the scrotum; but they have not succeeded sufficiently to encourage the surgeon to incur the risk of opening the cavities of the tunica vaginalis and the peritoneum, as well as the other dangers incidental to the operation. [These attempts have been followed by the death of the patients in most, if not all of the recorded instances. In none of them was the cremaster muscle divided (Agnew).]

Passage of the testicle into the perineum.—In a few instances the testicle has passed beyond its proper bounds, and has become

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the right groin, the testicle being undeveloped and detained in the inguinal canal. Dr. Gherini (Annali Universali di Med., vol. clix., p. 118; and Brit. and For. Med. Rev., vol. xxi., p. 268) relates two cases. Fatal peritonitis followed the opening of one; the other was cured.

[1] Curling, On Diseases of the Testis, p. 41. The removal of a retained testicle is an operation not unattended with danger, forasmuch as the sac of the tunica vaginalis usually, though not always, communicates freely with the cavity of the peritoneum. In a case of neuralgic testicle, retained in the lower part of the inguinal canal, and removed by Prof. Van Buren (Amer. Med. Times, March 16, 1861), the tunica vaginalis was closed at the internal ring, and did not extend into the scrotum.

I would remark, as a matter of some practical importance, that when hernia occurs with retained testicle, and indeed in other cases of congenital hernia, the stricture, if strangulation takes place, is usually in the neck of the sac; and it may be at some distance behind the internal ring, a pouch being formed between the peritoneum and the fascia transversalis, in which some of the hernia is contained. I have met with two examples of this. In each the external abdominal ring was tight and constricted the hernia; and we might have supposed this was the real stricture, had not the finger discovered that the bowel above was not free, but tightly strangulated more than an inch above the internal ring.

In a young man, whose testicle had descended only just below the external ring, hernia suddenly took place and was strangulated. The bowel, instead of passing downwards into the scrotum, ascended upon the oblique muscle nearly to the spine of the ilium. By drawing it forcibly downwards, and then manipulating above the ring, I succeeded in replacing it.

lodged in a pouch in the perineum. [It is suggested by Curling, that this is due to an attachment of the middle part of the gubernaculum to the integument of the perineum, and by Agnew, that it results from a continuity of the integuments of the perineum with those at the external

Fig. 492.

Right testicle in the perineum (Bryant).

abdominal ring.] In this situation it is a source of much inconvenience, being liable to be bruised in sitting or riding, so that it is necessary to use mechanical means for retaining it in the scrotum.

A patient with gonorrhœa complained of a painful swelling in the perineum; M. Ricord, supposing it to be a perineal abscess, was about to open it, but discovered it was the testicle. He met with another instance of the same kind.[1]

Whether, in these cases, the testicle traverses the scrotum on its way to the perineum, or passes from the external inguinal ring directly backwards, between the thigh and the scrotum, instead of downwards and inwards to the scrotum, is not easy to determine.

I was lately consulted by a gentleman, in whom the right testicle, of smaller size than the left, lay in the track just mentioned; that is to say, it was in the cleft between the scrotum and the thigh, having never entered the former, and the cord ran up from it straight to the external ring. He was not accustomed to ride on horseback, and did not suffer much inconvenience from the malposition.

Passage of the testicle through the crural ring.—Three cases of this are given by Mr. Curling: the testicle either making its exit through the saphenous opening and mounting upon the abdomen like a crural hernia, or lodging behind the fascia in the upper and inner part of the thigh. [In this situation it has been mistaken for bubo, and has even been punctured.]

Persistence of the canal between the tunica vaginalis and peritoneum.—This canal usually closes in its whole length soon after the testicle has reached the scrotum. Often, however, the process is delayed for a variable time after birth, in consequence, perhaps, of a hernia descending with the testicle; or the canal may be maintained by fluid secreted in the tunica vaginalis or in the peritoneum (it is not easy to tell which), and passing to and fro. In either case a remedy is to be found in a truss or pad applied upon the groin. Sometimes the closure is only partial, and spaces remain which may become distended with fluid, forming hydrocele of the cord; or a narrow channel may remain in the whole length, from the testicle to the abdomen, for years or for life. All surgeons of much experience will be able to confirm the following observation by Sir A. Cooper: "The opening of the tunica vaginalis, in some instances, remains small until the adult age, and it then becomes suddenly dilated by a protrusion of intestine, producing hernia congenita; and when the surgeon in the operation discovers its nature, the patient assures him that he never had a hernia until a few days before."[1]

Imperfect subsequent development.—Even though the descent of the testicles may take place properly, their subsequent development and growth may fail.[2]

[1] Prov. Med. Journ., vol. vi., p. 264. In the Brit. Med. Journ., 1858, p. 549, is the account of a case in which the testicle was thought to have been dislocated into the perineum by a blow upon the pommel of a saddle. The gland remained in its abnormal position, an inch in front of the anus. An operation was attempted by Mr. Partridge, for the purpose of replacing the testicle in its position. This being unsuccessful, the organ was removed. It is not improbable that this testicle had descended into the perineum in infancy, but was not a source of annoyance till the injury upon the saddle. Dr. Zeis (Archiv für Klinische Chirurgie, vol. ii., p. 81) was about to operate on a lad, aged fifteen, for stone in the bladder, when he found the left testicle in the perineum in the way of his intended incision, and he accordingly made the incision on the other side; the left side of the scrotum was very small. He quotes other cases of abnormal descent of the testicle into the perineum and crural region.

[1] This subject is more fully discussed in the essay on Hernia, at p. 671.

[2] Mr. Curling showed at the Pathological Society the undeveloped testes from a remarkably tall man, who had been through life almost hairless as regards the pubes, chin, and whiskers. Both testes were quite undeveloped, and though normal in structure, had not advanced beyond the state of early childhood. The man had never shown signs of any virility. He had not been defi-

In a single man, aged thirty, who died in Addenbrooke's Hospital of phthisis, I found the testicles no larger than horse-beans. They presented no trace of disease, were soft and even on the surface, with the usual lobular divisions in their interior; but instead of the ordinary glandular structure, there was a reddish granular substance in which I could discover no tubules. The epididymes were also small; the vasa deferentia were of their natural size; the vesiculæ seminales about half as large as usual; the prostate and bladder healthy; the penis of natural size; hair on the pubes, a beard and proper muscular development.

Inversion.—Now and then there is inversion of the part; the vas deferens and the epididymis presenting in front, and the body of the testicle being behind; and this may lead to difficulty of diagnosis when there is disease. The other day, examining a case of epididymitis, I was puzzled at finding the firm swelling in front and the soft part behind; soon, however, I discovered that the vas deferens descended along the forepart of the cord, and that the epididymis lay in front. On the opposite side the parts were disposed as usual. The same inversion has been noticed occasionally in hydrocele (see following section).

Hydrocele.

Of all diseases hydrocele of the tunica vaginalis testis is one of the most simple in its nature and the most easy of diagnosis and treatment. It consists merely in a preternatural accumulation of the fluid which naturally moistens the internal surface of the tunic. It is not of dropsical nature, and is not a usual attendant on dropsy; but is a purely local affection, the result of some change in the membrane, whereby the proper balance between secretion and absorption is lost. That change is probably of an inflammatory nature, or of the kind which some pathologists call irritation—that is, a condition akin to inflammation and easily passing into it. At any rate, it is often traceable to a blow or some cause likely to induce inflammation. [Such as the straining in urination due to stricture and the thickening of the tunic incident to advanced life. Epididymitis, syphilitic sarcoma, and relaxation of the scrotal tissues from heat, are all common causes of hydrocele. Sir Henry Holland records an instance in which it was hereditary, three or four successive generations in one family suffering from it.] Associated with the fluid we often find some of the ordinary products of inflammation, and it usually contains a larger proportion of the albuminous and saline constituents of the blood than are present in ordinary dropsical effusions. Sometimes fibrin is present, as indicated by spontaneous coagulation; or coagulation may be excited by the addition of a small quantity of the fibrin or red corpuscles of the blood.[1] Its specific gravity is about 1025; it contains rather less animal matter than serum, though more than the fluid of ascites or hydrothorax;[2] and there are sometimes blood-globules in various conditions, flakes of lymph, and, in elderly persons, fatty matters or particles of cholesterine floating in it. Now and then it is like milk;[3] on the whole, however, it is not very variable in its appearance or character. The quantity varies; usually it is under a pint, but sometimes amounts to several quarts. The hydrocele of Gibbon the historian is still, I believe, without a rival in this respect, the quantity removed by Mr. Cline in that case being six quarts. [In one case, two gallons were drawn at a single sitting.[4]]

There is commonly little change beyond the distension of the tunic caused by accumulation of the fluid. There is no vascularity, nor much thickening either of the sac or of the tissues external to it. [The reflected or scrotal portion of the tunic is usually thickened, fibrous, rough, or often calcareous.] Even the cremaster muscle undergoes little change; sometimes its fibres are rather coarse, more frequently they are thin and pale. The swelling has much the form which the tunic assumes when it is artificially stretched, after death, by the inflation of air, or the injection of fluid into it; that

cient in intellect; Med. Times and Gaz., vol. xx., p. 76; Trans. of Path. Soc., vol. xi., p. 157. Several instances have been recorded where the testes and other parts of the genital apparatus had not attained their proper development and position in idiots and others of feeble mind. This, however, is not always, or even usually, the case. Indeed, we know that the organs are commonly well formed; and the sexual propensities, uncontrolled by the moral faculties, are a source of much trouble in the management of these persons.

[1] Buchanan, in Proceedings of Phil. Soc. of Glasgow, 1845, Feb.; Schmidt, in Reichert und Du-Bois Archiv, 1861, p. 555; and Virchow, Die krankhaften Geschwülste, p. 157. See also Natural History Review, April, 1864, p. 160.

[2] Marcet and Bostock, in Med.-Chir. Trans., vol. ii., p. 374, and vol. iv., p. 73. Simon's Animal Chemistry, by Day, vol. ii., p. 495.

[3] In a case of this kind reported in Path. Trans., vol. xvi., p. 184, the milky appearance was due to the presence of fatty matter, which had probably been secreted from the tunica vaginalis.

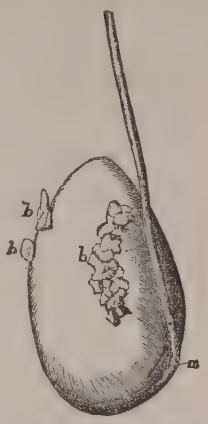
[4] Gross's Surgery, vol. ii., p. 851.]

is, it is pyriform, with the large end downwards, and there is often a transverse constriction, near the upper end. This constriction, which is also due to the shape of the tunic, as may be proved by blowing air into it, has often led to the supposition that there were two distinct sacs, or that there was a hernia in addition to the hydrocele.[1] [The fluid has been drawn off from one chamber without in the least affecting the size of the other.]

The *position* of the *testicle*, with regard to the tunic, regulates its position in the hydrocele; it is accordingly found at the lower and hinder part. The exceptions to this are few, and are commonly due to some change having taken place in the tunic, some unequal thickening of its coats, or adhesion of its surfaces, whereby the shape of its cavity is altered. Or there may have been congenital inversion of the organ, the epididymis presenting in front; in which case the testicle will be at the lower and *fore* part of the hydrocele.[2] Sometimes the testicle is in front, and we cannot quite account for the anomaly. As these varieties occasionally occur, the position of the testicle should in each be ascertained, if possible, before puncturing the hydrocele. For want of this precaution, I have, more than once, known the testicle pierced by the trocar, which was then either withdrawn or pushed on through the testicle into the hydrocele. No ill effect, beyond ecchymosis and slight inflammation, followed in these cases; but severe inflammation has followed this mistake in other instances. In children the testicle is said to occupy a lower relative position in hydrocele than in adults.

Condition of testicle.—Usually the testicle is sound, retains its natural size, is placed vertically, and projects into the cavity, so that it cannot be distinguished by manipulation, unless the walls of the sac are flaccid. The sensations of the patient, when it is touched, are some guide to its position, but must not be relied on. Sometimes it becomes flattened and spread out by the pressure of the fluid, and by the stretching to which it is subjected in common with the rest of the walls of the sac. The epididymis is then elongated, and the pouch, which naturally exists between the testicle and the epididymis, is obliterated. Sometimes, on the contrary, the testicle becomes separated from the hinder walls of the sac by an increase of the pouch just mentioned. This pouch, which projects towards the inner side of the testicle, may be so enlarged as to form a second sac, communicating with the larger sac by a neck, bounded in front by the testicle, and behind by the epididymis. Or the testicle may be projected into, even across the hydrocelic cavity, and, together with the structure connecting it with the epididymis, may form a septum dividing the sac, more or less completely, into two compartments. When this occurs, an alteration usually takes place in the axis of the testicle, so that it lies transversely, and the septum is also transverse.

Fig. 493.[1]



Hydrocele with pouch-like projections (*b*, *b*, *b*,) of the tunica vaginalis; *a*, testicle.

Other varieties occur in hydrocele. The sac may yield unequally, causing the shape to be more elongated or more spherical than usual; or circumscribed portions of the sac, yielding in a greater degree than the rest, may give rise to pouch-like dilatations, forming "bilocular" or "multilocular" hydrocele. Not long ago I dissected a hydrocele, which was covered all over with small pouches, communicating with the interior by narrow necks. Small cysts may be developed in the wall of the sac.[2]

[1] Sir B. Brodie (Med. Gaz., vol. xiii., p. 91) relates a case in which this "hour-glass contraction" increased so as to divide completely into two chambers a hydrocele which had been originally single.

[2] In a patient, aged thirty-six, who died of phthisis, I found a hydrocele on the right side, of about the size of a pear. The part was turned round, so that the testicle with the epididymis and vas deferens presented in front. The walls of the hydrocele were thick and opaque, with straw-colored calcareous plates and ridges upon its inner surface and in its substance. The body of the testicle was quite flattened, but of its usual size.

[1] This, and most of the other drawings in this essay, are taken from specimens in the Pathological Museum of the University of Cambridge.

[2] Museum of College of Surgeons, 2327.

Usually the wall of the sac remains thin and transparent for a long period, even though it is subjected to repeated tappings. Sometimes, however, especially if there have been an injury or effusion of blood into it from any cause, the tunica vaginalis becomes thick, opaque, and dense, even to cartilaginous consistence; and it may be the seat of earthy deposit. This may be uniform; or the interior of the tunic may be rendered uneven or knotty by projecting masses or lines and bands of lymph. Under such circumstances, the testicle becomes flattened, and perhaps wasted by the pressure of the contracting lymph upon it. The structure of the testicle is rarely injured or atrophied except in old hydroceles, where the tunic has become thickened or coated with lymph, and the fecundatory properties of its secretion appear not to be materially interfered with.[1] The effusion of lymph into the cavity may also lead to obliteration of parts of it, causing alterations in its shape, or adhesions between its surfaces at certain points, and to the formation of septa, dividing the sac into two or more compartments. These changes are probably, in most instances, consequent on the injection of irritating fluids into the cavity for the purpose of effecting a cure, which has only partially succeeded.

Tubular prolongation to abdomen.—The occasional persistence of a tubular communication between the cavities of the tu-

Fig. 494.

Hydrocele with adhesions of tunica vaginalis.

nica vaginalis and the peritoneum, constituting what has been called "congenital hydrocele," should also be borne in mind, and care should be taken in each case to ascertain whether it be so before injecting irritating fluids into the sac. Especially should this be done in children; and where there is hydrocele on both sides, in them, the suspicion of such a communication should always be entertained. An examination of the cord, and pressure upon the hydrocele, will usually decide the point, forasmuch as the fluid can be pressed from the tunica vaginalis into the abdominal cavity, and returns when the pressure is remitted. In this respect it resembles hernia, but there is not much difficulty in distinguishing between the affections. Besides being transparent, the swelling usually returns to some extent, although the patient be recumbent; and if the sac be emptied, it will gradually refill when the patient stands up, although the finger be pressed upon the inguinal canal with sufficient force to prevent the passage of a hernia. It must be observed that occasionally the tube connecting the hydrocelic cavity with that of the abdomen is so narrow as to escape detection when the cord is held between the finger and thumb; and it may even be so narrow as to permit the fluid to trickle very slowly from the hydrocele into the abdomen, so that its passage from one cavity to the other would escape observation on a cursory examination. [In congenital hydrocele the funicular process is closely adherent to the cord at the external ring. Above, although the peritoneum adheres partially to the cord, often sufficiently to prevent the descent of intestine or omentum, yet there is sufficient communication with the abdomen to allow of the passage of the fluid constituting the hydrocele.] There is a specimen of this kind in Guy's Hospital Museum. In such a case pressure upon the hydrocele, unless it is long continued, will make very little impression; and the nature of the case is likely not to be detected unless it have been remarked that the swelling is diminished when the patient has lain down some hours. Such cases, it is true, are rare; and I do not know of any in which mischief has resulted from the communication being overlooked, though I suspected it in one instance. [Agnew recommends the application of a truss, which, by compressing the sides of the canal together, favors the closure of the funicular process at the internal ring.]

In each of the following cases it would seem that the canal remained pervious, except quite at the upper end; and that when hydrocele took place the sides of the canal yielded where it passed through the abdominal wall, and were also dilated into a considerable pouch behind the abdominal wall.

Case I. A man, aged thirty-five, had large hydrocele on the right side, with the usual

[1] Med. Times and Gazette, Nov. 6, 1869, p. 542.

transverse constriction near the upper part. It extended up to the inguinal ring, and received an impulse when he coughed. Examining the abdomen, I found a fluctuating swelling at the lower part, like a distended bladder; and a distinct impulse was communicated from this to the scrotal swelling, so that it was clear there were two sacs, one in the scrotum, the other in the abdomen, communicating through the inguinal canal. The history was obscure. The patient was unconscious of any swelling in the abdomen, yet had worn a truss for supposed rupture. The scrotal swelling was attributed to a blow on the pommel of a saddle ten years before. It had gradually increased. A trocar passed through the scrotum gave vent to seven pints of serous fluid, emptying both sacs. The testicle lay at the inner and upper part of the scrotum. Pain and swelling of the left lower limb, with other indications of plugging and inflammation of the femoral vein, followed. These subsided, and the fluid was on three subsequent occasions drawn off. A more radical proceeding being desired, I made an incision into the swelling, and carried it up to the internal ring, so that there might be a free vent for the products of inflammation from the abdominal sac; then inserted lint. Suppuration ensued; and when the wound healed, the cavity was obliterated in its whole length.—Case II. A man, aged twenty-nine, had hydrocele on the right side, extending through the inguinal canal into the abdomen, and causing a fulness above the internal ring. It resembled a hernia in its shape, in the impulse received by coughing, and in the fact that the testicle could be felt, apparently distinct from it, at the lower part; but it was transparent and fluctuating. It was attributed to a blow received ten years previously, and was said to have commenced in the scrotum. There was inguinal hernia on the opposite side. I cut into the swelling cautiously; and as the abdominal swelling was smaller than in the preceding case, I did not carry the incision so high, but passed lint along the canal into the abdomen. Suppuration followed, and the disease was cured.[1]

Diagnosis of hydrocele.—The position and shape of the swelling, its termination below the external ring, so that the cord may be felt free above it, its lightness and fluctuation, and above all, its transparency, furnish such ready means of diagnosis, in the great majority of cases, that a mistake does not often occur. Still, as the requisite means of informing himself are so simple, the surgeon should not neglect to employ them in every case. Especially should he be careful to ascertain whether the swelling is transparent, not only on the first time of using the trocar, but also on each subsequent occasion on which he is called upon to puncture the swelling; and in making this examination he should be careful to press the swelling to the forepart of the scrotum between the fingers and thumb of one hand, so as to render the skin quite tense over it, while he screens his eyes from the light with the other hand placed over the scrotum. In a doubtful case I place the patient upon a table near a window, and use as a screen, in addition to my hand, a dark cloth, carefully adjusted over the upper surface of the swelling and covering my head. These precautions are necessary to avoid error. Assistance may sometimes be gained by looking through a stethoscope or tube. Transparency is a pretty sure indication of the presence of serum or other light-colored fluid, and is therefore a tolerably safe warrant for the use of the trocar. I have carefully examined hernia and other swellings for the purpose of ascertaining how far transparency may really be relied upon as an evidence of the presence of hydrocele or watery cyst in the scrotum, and have not found it to fail. That is to say, every swelling which has transmitted the light of a candle or the sun has proved to contain light-colored fluid. Even in the hernia of young children, where the bowel and its coverings are thin, the light of a candle placed close to the part fails to shine through.

Though transparency is thus a most valuable positive indication, yet the negative evidence afforded by its absence is by no means equally conclusive that the swelling is not of the nature of hydrocele; for the admixture of a small quantity of blood with the fluid will entirely prevent the transmission of light; and a considerable increase of the thickness of the sac may have the same effect. Under these circumstances, the diagnosis is more difficult, and may perhaps not admit of being satisfactorily established without making a puncture with a grooved needle or a trocar, or an incision. Such a hydrocele, extending into the inguinal canal, so that its upper end cannot be defined with the finger, and so that it acquires an impulse from coughing, simulates hernia very closely. The history of the case, indicating whether the swelling commenced in the scrotum, and ascended to the groin, or in the groin, and descended to the scrotum, may assist in the diagnosis. The patient should be examined in bed to ascertain whether the recumbent position causes a diminution of the swelling. In non-congenital hernia, moreover, the testicle may usually be felt at the lower part

[1] Professor Syme relates a case of "abdominal hydrocele" in a child aged four or five. The fluid was contained, not in the tunica vaginalis, but in an expansion of the cord. British Medical Journal, 1861, p. 139. The dissection of a similar case is given by Mr. Lister, in Edinburgh Medical Journal, September, 1856.

of the scrotum, which cannot often be done in ordinary hydrocele. [In hydrocele the tumor is cylindrical or ovoid, flat on percussion, often fluctuating, is tense, stands off from the body, and if pressed backwards springs forward again. In hernia the tumor is pyriform or round, percussion is usually resonant, it is not tense, and is heavy or pendulous and not elastic.] In a doubtful case it would be more prudent to cut cautiously down to the part than to thrust either a trocar or a grooved needle into it.

The two affections, hernia and hydrocele, are not unfrequently combined; and the hernial swelling may come into contact with the hydrocele, so as to communicate to it the impulse received in coughing. The nature of the case may usually

[Fig. 495.

Hydrocele associated with hernia (Gross).]

be ascertained by examining the patient in the recumbent position. The contiguity of the hernia need make no difference in the treatment of the hydrocele, for the inflammation excited in the latter by injections or other means is not likely to extend to the hernia. The hernia may not only reach the hydrocele, but may descend into the scrotum in front or behind the hydrocele, or on one side of it. Sometimes the hernial sac, with its contents, has projected into the hydrocele. Out of six cases of this kind which M. Dupuytren witnessed,[1] he only twice saw symptoms of strangulation resulting from constriction of the organs at the place where they were engaged in the serous pouch of the testicle.

The distinction of a non-transparent hydrocele from hematocele, cystic, and other tumors of the testicle, is sometimes quite impossible without resorting to the aid of a trocar or an incision. An incision is usually to be preferred, because more information is obtained by it, and because, if the swelling turn out to be a hydrocele with thickened sac, a free incision, followed by suppuration, is, on the whole, the best treatment. The following case is an illustration of the difficulties occasionally met with in the diagnosis of hydrocele.

A man, aged forty-five, had swelling of the left testicle as large as a cocoa-nut, heavy as if it were solid, and with indistinct feeling of fluctuation; not the slightest transparency; slight constriction near the middle; large tortuous veins upon its forepart; the cord healthy. He said that twenty years before he received a sabre wound, which left the testicle about twice its natural size, and it remained so till October 19, 1860, when he had a blow, after which the part became swollen and painful. The swelling continued, and the case was supposed to be hematocele. Yet on November 2, a trocar gave vent to twelve ounces of the ordinary straw-colored fluid of hydrocele, and the sac was found to be much thickened.

Hydrocele appears on each of the two sides of the scrotum in about an equal number of cases, and is most frequent between the ages of thirty and fifty. It is also common in elderly persons.[1] It usually forms slowly, and is painless, being inconvenient only from its bulk and weight. In some cases, however, it is attended with a good deal of pain. I have observed this to be so when the fluid is re-accumulating after tapping more frequently than when it is collecting for the first time. Sometimes the hydrocele is a remnant of an acute inflammatory attack in the epididymis, or is an attendant upon inflammatory or other disease in the testicle. Under such circumstances lymph is usually mingled with the serum; and when the disease subsides, the fluid is commonly absorbed, though the lymph often remains, and causes adhesions between the surfaces of the tunic.

Treatment.—Although the morbid condition upon which the accumulation of the fluid depends must be of the faintest possible kind, yet we know of no means by which it can be arrested and the resorption of the fluid induced. All the measures we are in the habit of adopting

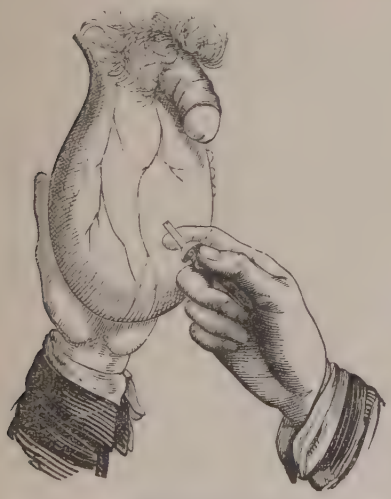
[1] Medical Gazette, vol. xii., p. 686.

[1] It seems that other alterations in the tunica vaginalis are also common in advancing years. Dr. Duplay (Archives générales de Médecine, aout 1855, p. 132) gives an account of the examination of these parts in 59 persons, whose ages ranged from sixty to eighty-six. The tunica vaginalis was more or less altered in 44; in 12 it was thickened; in 17 there were adhesions; in 15 there was hydrocele; and in 4 cartilaginous or osseous bodies hanging by narrow pedicles.

with the view of checking secretion or promoting absorption are valueless, or nearly so, in this instance. Mercury and iodine, whether given internally or applied outwardly, vesicatories or pressure, however carefully employed, are almost invariably useless. The swelling slowly continues in spite of them; and if limited at all, is so only by the resistance of the surrounding tissues to further distension. In this respect, it is true, hydrocele is but an example of a class. In other diseases of the like kind—hydrocephalus, hydrothorax, hydrops articuli, etc., — the morbid change determining the accumulation of the fluid is slight, almost inappreciable, and the resistance to remedies is as great, or nearly as great, as in hydrocele.

Happily this feature is of no great importance in the cure of hydrocele; and we should not have much inducement to persevere with treatment of this sort, even if it were much more effectual than we know it to be; for the removal of the fluid by a trocar is so simple, quick, and painless a proceeding, that we do not hesitate to resort to it as soon as the swelling has become a source of inconvenience. An interspace between the veins should be selected where the sac is transparent. The lower and forepart is usually chosen; and the point of the instrument should be directed upwards to avoid wounding

[Fig. 496.



Operation of tapping a hydrocele; the trocar entering the tumor (Gross).]

the testicle. There is no advantage in incising the skin with a lancet before introducing the trocar, or in placing any plaster or other dressing upon the wound afterwards. I have never known any bad results to follow the tapping, though my patients are often obliged to walk some miles to their homes immediately after the operation. That some risk, however, attends upon it is shown by cases in the practice of Sir A. Cooper, Mr. Curling and others, where sloughing of the scrotum has followed, and has even proved fatal. In some instances effusion of blood into the sac, from a wounded vessel, forming a hematocele, has taken place.[1]

The relief afforded by tapping is, however, only temporary. The fluid is almost sure to collect again, and, in all probability, it will be necessary to repeat the operation in the course of a few months. The patient may be content with the relief afforded by periodical tappings, or may be unable to spare the time requisite for effecting a cure. Should this not be so, it is well at once to inject into the emptied sac, through the canula, some fluid which is calculated to incite smart inflammation of the tunic; it being found by experience that this will, in most cases, lead to a cure. Many fluids have been tried—port-wine, solution of sulphate of zinc, etc.,—the mode of action of all being the same; and they, or the chief part of them, are allowed to return through the canula after a period varying from a few minutes to half an hour. The most convenient plan, and the one which, from the small proportion of failures, seems to deserve its present popularity, is to throw into the sac two, three, or more drachms of the tincture or some solution of iodine, and to allow it to remain. [The amount of the injection should be proportionate to the size of the sac.] While the canula is being withdrawn, after the injection, the sides of the sac should be nipped between the finger and thumb to prevent the escape of the iodine from the sac; and the scrotum may be shaken a little roughly, so as to ensure the contact of the fluid with all parts of the interior of the sac.[2]

[1] Mr. Davy (British Med. Journal, 1857, p. 593) relates that he tapped an enormous hydrocele, hardly smaller than the body of a robust child, and removed a washhand-basinful of serous fluid. His intention was to remove the contents by instalments, so he repeated the operation a few days after. This was followed by violent inflammation of the scrotum and contiguous parts, threatening general sloughing of the scrotum. Many and deep punctures were, however, made, followed by fomentation; the inflammation and swelling gradually subsided, and the hydrocele was cured.

[2] Mr. Davey (British Med. Journal, March 15, 1862) appears to attribute his success in the treatment of numerous cases of hydrocele in Ceylon, with an injection of sulphate of zinc (2 grs. to 1 dr.), to his being in the habit

The inflammation following the injection of a hydrocele is not confined to the tunica vaginalis, but extends to the cellular tissue and skin of the scrotum, and usually to the epididymis. I think iodine has the advantage over the other fluids just mentioned, in that the inflammation excited by it is more moderate and uniform in degree; it is rarely very severe, yet generally sufficient for the purpose. The patient had better rest in bed for a day or two, but need seldom be confined longer; and it is rarely necessary to resort to any additional measures for increasing the amount of inflammation, such as rubbing the sides of the sac together, or irritating the skin. The inflammation and swelling subside spontaneously. Some enlargement and hardness may remain for weeks, or even for months, but it is usually of no consequence. We need not despair of a cure, though the inflammation be very slight; for in some cases, in which scarcely any pain or swelling followed the injection, the hydrocele has not returned. In some the fluid has re-collected, so that the part was in much the same condition as before the operation, and then has gradually been absorbed. It is well, therefore, to wait for a considerable period before resorting to any further treatment. The cure is usually permanent, though in a few instances the fluid has returned after a lapse of some years.

We learn by dissection that the inflammation consequent on the injection of iodine, or other stimulating fluid for the cure of hydrocele, is attended commonly with the effusion of lymph upon the surface of the tunica vaginalis, and of fluid into the cavity of the tunic. The fluid is tinged with blood; hence, if the part be examined a few days after the injection, though there may be a good deal of fluid in the sac, it will seldom be found translucent. Subsequently, as the fluid becomes absorbed, the opposed surfaces of the tunic come into contact, and are, more or less, united by lymph. The adhesion may be general, so that the cavity is quite obliterated, or filled up by the fine areolar tissue into which the lymph, in course of time becomes converted; or the adhesion may be partial, leaving spaces in which fluid may still collect; or it may be confined to a few bands or threads connecting the surfaces. Lastly, the lymph may be in such small quantities, or may be so nearly absorbed, as to leave the membrane pretty much in a natural state. This has been found in some cases in which the hydrocele has been cured; so that it would seem the mere passing of inflammation upon the membrane may induce such a change in it as to prevent the reaccumulation of the fluid.[1] Very rarely does the inflammation proceed to suppuration. Sir B. Brodie has known it to do so in three cases, and Mr. Curling in one.

Although ill effects rarely follow the injection of hydrocele, it is not worth while to run the risk of exciting inflammation in a very large sac; when, therefore, the fluid exceeds a pint, it is advisable simply to tap the sac, and on a subsequent occasion again to draw off the serum before so large an accumulation has taken place. The injection may then be resorted to with comparative safety.

The presence of some disease in the testicle, even though it be the cause of the hydrocele, does not necessarily constitute an objection to tapping; indeed, much relief may sometimes be given by drawing off the water. It is not, however, advisable to inject the sac under these circumstances; *first*, because the inflammation so caused is likely to aggravate the disease in the testicle; and, *secondly*, if the disease in the testicle subsides, the hydrocele commonly disappears spontaneously. Occasionally, after tapping a hydrocele, we find the testicle somewhat enlarged and indurated, in consequence of chronic inflammation which has taken place in the body of the gland, or in the epididymis; and the question arises whether this constitutes an objection to the radical treatment of the hydrocele. If the enlargement be considerable, the part tender, and the hydrocele recent, the proper practice is to wait for a time, and, under appropriate treatment for the disease of the testicle, the enlargement and the hydrocele will probably disappear altogether; but if the hydrocele be of some standing, and the affection of the testicle slight, there is no objection to injecting the sac.

Acupuncture causes a temporary diminu-

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of kneading the scrotum for a minute or two, so as to bring the zinc with some force into contact with the whole interior of the sac.

In the same journal (February 22, 1862) is the account of a case of hydrocele in an elderly man tapped and injected with three drachms of turpentine. More inflammatory action than necessary followed, with suppuration in the scrotum, and a cure.

Now and then the mere rubbing together of the surfaces of the tunica vaginalis, after the complete evacuation of the fluid, has been followed by sufficient inflammation to effect a cure. This simple method, however, will not often succeed.

[1] In sixteen cases successfully treated in various ways, M. Hutin found the cavity of the tunica vaginalis quite obliterated in eight; the adhesions of its surfaces were only partial in four, and in four there were no traces of them. Arch. gén. de Méd. cinq. série, tome ii., p. 218.

tion of the swelling, the fluid passing through the openings made by the needle into the areolar tissue of the scrotum, where it is absorbed. It is not to be relied on as a means of cure, for the fluid usually re-collects as soon as the punctures in the sac have healed, though it is thought to do so less quickly than when the trocar has been used.

In several instances I have tried the plan of inserting a little *nitric oxide of mercury* upon a moistened probe passed through the canula, after the fluid had been evacuated. It commends itself by the facility with which it is done, and it is very successful. The inflammation which it excites is, however, more severe than that caused by iodine; and in two cases in my own practice this treatment was followed by salivation. I have therefore ceased to adopt it. I have found the wire seton open to the objection made to it by others, viz., that it is liable to be followed by troublesome suppuration.[1]

An incision into the sac, the wound being kept open so as to cause suppuration, is an effectual method, though unnecessarily severe for ordinary cases. It confines the patient to bed for some time, and is not altogether unattended with danger. The inflammation which follows is sometimes very acute, and accompanied by a good deal of constitutional disturbance. In Guy's Hospital Museum is a specimen of tunica vaginalis said to have sloughed away under these circumstances. The procedure is suited to the cases in which the sac is thickened, and in which an exploratory incision is required to ascertain the real nature of the disease; also to cases in which milder means have failed. In two of the instances in which I have resorted to it, plugging and inflammation of the veins of the lower limb ensued, but were productive of no permanent ill effect.[2]

Spontaneous cure, though common in infants, is very rare in after-life; so rare that the prospect of it is not worth taking into account. It has happened from a blow,[3] or a violent effort in coughing, and during a fit of the gout, from inflammation of the tunica vaginalis, and gradually without any apparent cause.[1]

Infantile hydrocele is very common. It generally takes place after the communication with the peritoneal cavity has been obliterated, but may appear before. It is easily recognized, owing to the thinness of the coverings giving ready transmission to light. It usually subsides spontaneously, and needs, consequently, little attention. The cure may perhaps be quickened by stimulating the skin with iodine or zinc lotion, or by puncturing the sac with a needle in two or three places. In considering the advisability of any more active treatment the probability of a communication with the abdominal cavity is to be borne in mind (p. 900).[2]

[The introduction of a seton is almost invariably followed by cure. The sac should be punctured with a sharp-pointed bistoury, and before the latter is withdrawn there should be introduced along its blade a needle threaded with silk. This should be brought out through the scrotum, and the thread should be tied loosely. After one, or, at the most, two days it should be removed. The resulting inflammation should be treated with rest, anodyne lotions, etc.]

Encysted Hydrocele.

Cysts are very often found in connection with the testicle; and a good deal of pathological and practical interest attaches to them. They have received the careful attention of able anatomists and surgeons, and have been the subjects of several essays,[3] and are numerously displayed in our museums; but their origin

[1] See Dr. Gillespie, Edin. Medical Journal, January, 1862. The conclusion to be arrived at from a paper and discussion at the Edinburgh Med.-Chir. Society is, that the effects of the wire seton are very uncertain. In some cases little or no inflammation is induced, in others severe suppuration. Edin. Medical Journal, vol. vii., p. 1074.

[2] For an account of other modes of treatment, see Curling, On Diseases of the Testis.

[3] Pott's Works, by Earle, vol. ii., p. 292. In other cases, where the swelling has disappeared after a blow, and the patient has thought himself cured, he has been disappointed by the return of the fluid.

[1] Brodie, in Medical Gazette, vol. xiii., p. 90.

[2] Dr. Linhart (Froriep's Notizen, 1856, vol. ii., No. 4; Brit. and For. Med. Rev., July, 1856) recommends in such cases subcutaneous incision of the tunica vaginalis, which allows the fluid to become effused into the scrotum, where it is rapidly absorbed. M. Richard (Gazette des Hôpitaux, 1857, No. 41, and B. and F. Med. Rev., July, 1857) removes the fluid with a very small trocar, and then injects a small quantity of alcohol, an assistant compressing the track of the inguinal canal for a minute or two; experience having shown that the persistence of the communication with the abdomen is not of the importance that might have been expected.

[3] Brodie, in Medical Gazette, vol. xiii., p. 137. Gosselin and Duplay, Archives générales de Médecine, 4e série, tome xvi., pp. 24 and 163; and 5e série, tome vi., p. 139. Liston, Lloyd, and Paget, Med.-Chir. Trans., vols. xxvi. and xxvii. Luschka, Virchow's Archiv, vol. vi., p. 310. Curling, Diseases of the Testis, p. 130, etc.

and nature still remain to be clearly made out.

They may most conveniently, if not most correctly, be thrown into two groups —the *small* cysts and the *large*. Those included in the former group seldom or never attain to a greater size than a pea, are of very simple nature, commonly do not attract attention during life, and do not require treatment; whereas those in the second group may attain to indefinite magnitude, and become, therefore, objects for diagnosis and treatment. Some of these are also less simple in their nature and contents.

The *small cysts* are found in as many as a half of the testicles examined after the age of forty. [In a collection of thirty-five testes in the museum of the University of Pennsylvania, six were affected with cysts.] They are rarely met with before puberty. They lie immediately beneath the serous coat of the epididymis more frequently than on the body of the testicle. When they occur upon the latter, they are situated between the tunica vaginalis and the tunica albuginea; when on the epididymis, they are situated, apparently, between the tunica vaginalis and the proper investing fibrous coat of the part. Thus they seem to be related rather to the serous or subserous tissue than to the organ itself. They may be dissected clean out without interfering with the tubular structure; and no communication can be shown to exist between them and the tubules. Each has a proper fibrous tunic of its own, and contains clear fluid, in which are simply granules and epithelial scales, with occasionally small crystals—never spermatozoa or other spermatic elements. They may be single or in numbers. Sometimes they appear as mere points beneath the membrane; sometimes they cause slight elevations of it; and sometimes they project it till they acquire a polypose form, and hang into the cavity of the tunica vaginalis. Their pedicles may become long and narrow, and may even give way, leaving the cyst free in the cavity. Possibly the small fibrous, cartilaginous, and calcareous bodies occasionally found in the cavity of the tunica vaginalis originate in these small cysts, which have become detached, and have solidified and undergone other changes while lying loose in the cavity. Sometimes they burst, and, after having discharged their contents into the cavity, shrivel and are converted into small solid remnants. It is possible that the irritation occasioned by them may sometimes give rise to hydrocele. With this exception they are not productive of any symptoms or inconvenience, and do not come under the notice of the surgeon.

The *large cysts* are less common than the preceding, and are not limited in their size, having been known to contain twenty, and even forty, ounces. They are composed of a fibrous tunic, lined by delicate tesselated epithelium. Some of them contain only serous fluid, much resembling that of common hydrocele. In many of them, however, the fluid is paler than serum, more like water; or whitish, milky,[1] not quite transparent. It then commonly gives little or no evidence of albumen when it is heated; and when it is placed under the microscope it often shows spermatozoa and spermatic cells in greater or less quantity. When the fluid is fresh, the spermatozoa are often lively in their movements, and have been sometimes found to be abundant in the fluid removed from the cyst, although they existed scantily, or not at all, in the tubules of the testis and of the epididymis. Sometimes they are less active, or incompletely or ill formed. The presence or absence of spermatozoa may usually be determined by the character of the fluid, whether it be watery or serous. Accordingly, on tapping a hydrocele, if the fluid evacuated be watery or whitish, we may be pretty sure that it is of spermatic character, and that it was contained, not in the cavity of the tunica vaginalis, but in a cyst. We read, it is true, now and then, of spermatic fluid being withdrawn from the cavity of the tunica vaginalis, and it is possible that it may be so. The fact, however, has seldom been proved by dissection. The only instance of the kind that I am acquainted with is one described by Luschka; and the presence of the spermatozoa in the hydrocelic fluid was, in that case, shown to be due to the bursting of a cyst into the cavity of the tunica vaginalis.

Spermatozoa, then, with very rare exceptions, are peculiar to encysted hydrocele, but are not present in all cases of that disease. The question arises, what relation do they bear to the containing cysts? Is their presence merely accidental, consequent on a communication being formed between the cyst and one of the tubes of the epididymis by rupture of the latter from a blow or other cause? This view is taken by some pathologists. We must bear in mind, however, that such communications between secreting and other tubes with cysts, abscesses, or other sacs formed in their neighborhood, very rarely occur. Certainly, our experience of such a process in other parts of the body does not warrant our looking to

[1] The milky cysts do not always contain spermatozoa, and the white or faint yellow color of the contents is probably due to the presence of fatty matter and granules.

it for the explanation of so common an occurrence as the presence of spermatozoa in encysted hydrocele. Moreover, the other characters of the fluid (the absence of albumen, etc.) in these cases indicate that it is *sui generis*, and not a mere resultant of the addition of sperm to the fluid of an ordinary cyst. Mr. Paget takes the view that the spermatic contents are a product of the cyst itself, and thinks that cysts seated near the organ, which naturally secretes the material for semen, may possess a power of secreting a similar fluid. To this, however, must be objected the improbability that so exact an imitation of a complex and highly-wrought secretion should take place in a cyst developed merely in areolar tissue, and unconnected with the secreting tissue of the gland. It is difficult to believe in such an

Fig. 497.

Spermatic cysts. *aa*, closely connected with the upper part of the epididymis; *b*, spermatic cyst lying under the upper end of the epididymis and closely connected with the testis; *c*, tunica vaginalis reflected.

approach to the spontaneous generation of spermatozoa after the developmental energies of embryonic life have passed away. One cannot help suspecting that the spermatic corpuscles of these cysts are the offspring of the spermatic corpuscles of the proper secreting tubes, and that the cysts themselves are, in some way or other, offshoots from those tubes. Luschka observed distinct communication between the spermatic tubes and the cysts in each of the cases examined by him; the opening of the tubes into the cysts being large enough to admit a bristle, and to permit mercury to pass from the tubes into the cysts, or *vice versâ*. Similar communications have been found by Curling and others. In other instances, however, equally careful observers have failed to discover any communication of the sort, or, indeed, any connection between the cysts and the tubules. They describe the cysts as possessing complete capsules of their own, invested all round by areolar tissue, which separated them from surrounding structures, and permitted them to be dissected away without any injury to those structures. It is quite possible that, in such instances, the cysts may have originated in the tubes and have lost their connection with them as growth went on. For the present, however, the question of the real origin of these sperm-bearing cysts must remain an open one.

[Fig. 498.

Encysted hydrocele of the testis (Curling).]

They are usually found in or near the epididymis, so near that they may fairly be presumed to have originated in it.[1] Sometimes two or more coexist; and sometimes the whole epididymis is occupied by, or transformed into, a mass of cysts. Occasionally the spermatic cysts are associated with common hydrocele,[2]

[1] This position has suggested that they may originate in some of the tubes of the Wolffian body, which have not become connected with the testicle, and which, therefore, remain as blind canals or sacs. Virchow, Die krankhaften Geschwülste, p. 282. This pathologist believes that after a time they may lose their spermatic character and become simple serous cysts.

[2] "I tapped the lower hydrocele, and a yellow serous fluid was discharged; but still

or with cysts which contain mere serous fluid. The latter are not always so closely connected with the epididymis as the former.

In a few instances large cysts have been found upon the tunica albuginea testis, between it and the visceral layer of the tunica vaginalis, or in the substance of the tunica albuginea; but I am not aware that spermatozoa have been detected in the cysts so situated.[1] [These cysts are quite rare. The one figured here was discovered accidentally after death by Mr. Curling, and is preserved in the museum of the London Hospital.

Fig. 499.

Hydrocele between the tunica albuginea and the inner layer of the tunica vaginalis (Curling).]

Diagnosis.—Encysted hydrocele corresponds in its general features with ordinary hydrocele, being a light, fluctuating, transparent swelling, connected with the testicle. It differs from ordinary hydrocele in its relation to the testicle, being situated above or below it, or to one side, instead of enveloping it. [The swelling is apt to be tense, usually follows the movements of the gland, is often attended with considerable pain, and, if the cyst is multilocular, has an uneven surface.] Sometimes the cyst may be felt quite distinct from the organ, giving the impression of an additional testicle. As the cyst increases, the testicle is borne upon its wall, and may still often be recognized as a distinct substance, perhaps quite at the lower part of the swelling, more rarely on one side, above, or in

[Fig. 500.

Encysted hydrocele (Druitt).]

front. This projection of the testicle may be the only means of distinguishing an encysted from an ordinary hydrocele; and it is by no means a sure one, for we sometimes find the same thing in common hydrocele, owing to adhesions or other cause. Sometimes the cyst projects into the sac of the tunica vaginalis, distending it in the same manner as if the fluid were contained in the cavity. Then, and under some other circumstances, it is impossible to tell whether the fluid be in a cyst or not; and it is no uncommon thing for the surgeon to be first informed of the nature of the case on finding the fluid evacuated by his trocar to be of the watery nature of the encysted hydrocele instead of being the serous fluid of ordinary hydrocele.

Treatment.—Happily the diagnosis between common and encysted hydrocele is not very important; for the treatment of the two is the same. The fluid should be evacuated when its quantity is such as to be a source of annoyance; and the sac may be injected with iodine. The prospect of a radical cure is not so good in encysted as in common hydrocele; but success has followed in a sufficient number of cases to encourage the adoption of

half the swelling remained. I then darkened the room, ordered a candle, and examined the swelling, which extended from the upper part of the testis to the abdominal ring. It was very transparent; I therefore tapped it, and drew off a fluid like water, quite free from color, which contained some coagulable matter, but less than common serum."—Sir A. Cooper, On the Testis, p. 170. This was probably a spermatic cyst, and such cases are not very uncommon.

[1] In Trans. of Path. Soc., vol. vii., p. 247, is the dissection, by Mr. Hutchinson, of "a thick-walled cyst, size of a goose's egg, developed in the layers of the tunica albuginea, and by which the gland-structure itself had been displaced downwards."

this plan, and even to justify its repetition should the first trial fail. I am not aware that any ill consequences have ensued upon it. The palliative treatment of merely drawing off the fluid has this recommendation, that the fluid does not usually re-collect in the cysts as quickly as in common hydrocele. It should be observed that these cysts sometimes attain to a certain size, and then remain stationary for years; so that, unless they are increasing inconveniently, they may be left alone.

Hydrocele of the spermatic cord consists in the accumulation of fluid, which is usually of serous character, like that of hydrocele, in a bag in some part of the spermatic cord. It may be near the testicle, or near the internal ring, or at any intermediate point. It rarely attains to a larger size than that of a hen's egg. The bag is thin, and probably consists, in most instances, of an unobliterated portion of the canal of the tunica vaginalis, which has become distended by an accumulation of fluid in it. This view is entertained by most surgeons; and is supported by the fact that unobliterated portions of this canal may not uncommonly be discovered, by dissection, in young persons and in adults. The hydrocele is usually oblong, its long axis corresponding with that of the cord; it is surrounded by the loose areolar tissue of the cord, which admits of its being easily dissected away. Sometimes, probably, an independent cyst is formed, constituting *encysted hydrocele of the cord;* but the two conditions are not distinguishable from one another during life, even if they be on careful dissection. [Fig. 501.] They need not, therefore, be considered separately.[1]

Diagnosis.—The sac and its contents are commonly transparent. This may be ascertained by fixing the sac in a particular position, stretching the skin tightly over it, and adjusting the light carefully; and it is often the only means of distinguishing the disease from hernia and other swellings. When the sac is situated below the external ring, and can be felt as an oval, defined, fluctuating swelling, there is no difficulty. But when the sac is higher, and, in consequence of the laxity of the investing tissues, can be slipped to and fro in the inguinal canal, ascending in the recumbent, and descending in the erect posture, and acquiring an impulse from coughing, its nature can be recognized with certainty only by its transparency.

[Fig. 501.

Encysted hydrocele of the cord (Bryant).]

The following cases indicate some of the points of difficulty in the diagnosis of this affection:—

A man, aged thirty-five, had a swelling above the right testicle (which was rather indurated), extending along the cord, through the inguinal canal, to the abdomen. It felt like a hernia, and received a distinct impulse when the patient coughed. It did not, however, diminish in the recumbent position; it was said to have followed a blow upon the pommel of a saddle; and, when examined by the aid of a candle, it was found to be transparent. I introduced a trocar, and drew off six ounces of straw-colored fluid. The swelling partially returned, but subsided under the external application of iodine, and there was no trace of it two years afterwards.

Compound spermatic cyst.—A youth, aged nineteen, had a swelling on the right side of the scrotum, closely connected with the upper and forepart of the testicle. Fluctuation could be perceived in it, and transparency when the skin was stretched tightly over it. Above this, at the external ring, was a small soft swelling, doughy, not distinctly fluctuating. Like a hernia, it went up into the abdomen, quite out of reach, when he was laid down, and returned again when he stood up or coughed. It also communicated an impulse to the finger when he coughed. He wore a truss, which had been ordered by an experienced surgeon at a hospital; and it was thought to be a case of hernia by most of those who examined it at our hospital. I was induced to examine more carefully by observing that the impulse was less distinct than it usually is in hernia. Moreover, when he stood and coughed the swelling seemed to bolt past my finger and thumb, which, with a little pressure, met together above it; and I thought I could press it to and fro, as though it were a distinct cyst or tumor, and not a swelling prolonged into the abdomen. When he was laid down, and the swelling had disappeared, it could be brought into view, and even brought beyond the external ring by traction upon the cord. When thus pulled down, with the skin drawn tightly over it,

[1] Mr. Gamgee examined in the Pathological Museum of the University of Pisa, the calcified cyst of a hydrocele of the human spermatic cord of about the shape and size of a hen's egg. Surgical Researches, p. 193. In several instances blood has been found in the cysts of the cord.

the light of a candle could be seen through it. I accordingly cut down carefully through the cremaster, which was unusually distinct, and the other coverings, and exposed a sac, in which we could perceive that there were membranous contents capable of being moved about, and we could see vessels upon them. They looked and felt like omentum or intestine in a hernial sac. I again had recourse to the candle, and, finding that the swelling was quite transparent, and that its contents could not be returned into the abdomen while the cord was fixed, I opened the sac, giving vent to some clear fluid, and exposed several thin-walled cysts, bearing vessels, and containing clear fluid. Some were as large as a bean, the others were smaller. They were connected together and with the upper part of the cyst, which proved to be a closed sac, unconnected with the abdomen. I cut away the mass of cysts with a portion of the containing sac; and then opened the lower and larger swelling, which appeared to be formed by a portion of the tunica vaginalis distended with fluid. Suppuration ensued, the wound healed up, and the lad recovered.

Hydrocele of a hernial sac containing omentum.—A man, aged fifty, was the subject of supposed incarcerated hernia. He had suffered from rupture many years; used to return it when it descended, and perceived a gurgling in doing so; had worn a truss. A week previously to my seeing him, it came down and was painful; and, as he could not return it, he applied to a surgeon, who made many ineffectual attempts to reduce it, and, failing, kept him in bed on low diet. The swelling presented the appearance of an inguinal hernia, was larger than a goose's egg, with a narrow neck extending up the inguinal canal—so narrow that I thought it could scarcely be traversed by intestine. Accordingly I examined the swelling with a candle, and found it transparent. There being no urgent symptoms, I directed the patient to get up and take some aperient medicine and his usual diet. A fortnight after, the swelling remaining the same, I introduced a trocar and drew off four ounces of straw-colored fluid. There remained in the sac a long firm substance extending up the inguinal canal and feeling like a piece of omentum. The fluid reaccumulated, and the swelling was a source of great annoyance; so I made an incision into it. It proved to be a hernial sac containing a strip of omentum and four ounces of serous fluid. There was no communication with the abdominal cavity. The sac was left open, suppuration ensued, and the man quite recovered.

Transparent swelling in and near the inguinal canal proving to be abscess.—A young woman had a fluctuating swelling, as large as a turkey's egg, over the region of the right external inguinal ring, extending towards the pubes in the one direction, and along the course of the inguinal canal in the other. It was seen to be transparent when examined with a candle, and was thought possibly to be a cyst or collection of fluid in the canal of Nuck. It had commenced two years previously, was gradually increasing, and was a source of much inconvenience. I made a careful incision into it, and gave vent to a quantity of serum, followed by thin pus and masses of soft white lymph. It was evident that the pus-corpuscles and the lymph had subsided to the bottom of the abscess as the patient lay in bed, and had left the exposed part full of serum only, and, therefore, transparent. A free vent was given to the pus; gradually the discharge ceased, and the part healed.

The *diffused hydrocele of the spermatic cord* described by Pott and Scarpa, and appearing to consist in a simple and local œdema of the cord, I have never seen; nor can I make out that any cases of the kind have fallen under the observation of modern surgeons. At any rate it is a very rare affection; and it is sufficient to refer to the account of it given by the authors just mentioned.[1]

[*Treatment.*—If the collection of fluid in the cord be small, it need not be interfered with. If it be large enough to cause annoyance, the interior of the sac may be scarified with a small tenotome, and a compress and spica applied; or two or three fine silk setons may be introduced and left for thirty-six hours; or the fluid may be evacuated by a trocar and canula, and iodine injected.]

Hematocele

consists in an effusion of blood, either into the cavity of the tunica vaginalis, or into a cyst connected with the testicle or the cord. We have, therefore, "Hematocele of the tunica vaginalis," "encysted hematocele of the testis," and "hematocele of the spermatic cord." It is usually caused by a blow, and not unfrequently supervenes upon hydrocele, common or encysted. The source of the blood, in such case, is some ruptured vessel or vessels in the tunica vaginalis, or a small wound penetrating the tunica vaginalis[2]

[1] Pott, "On the Hydrocele of the Cells of the Tunica Communis," in his Chirurgical Works, by Earle, vol. ii., p. 224. Scarpa "Sull' Idrocele del Cordone Spermatico," in his Opusculi di Chirurgia, vol. i., p. 137. Mr. Flower (Med. Times and Gaz., vol. xvii., p. 109) describes a case of diffused hydrocele, below the testis, of the gubernaculum testis; the testicle was retained in the inguinal canal.

[2] "A man was brought into Guy's Hospital who had long had a hydrocele, and had received a severe blow upon it, which suddenly increased the swelling, bruised the scrotum, and produced great pain from distension. I immediately made an incision into it, and discharged a large quantity of water and coagulated blood; and found a rent in the

[or the vessels of the testicle itself]. It may also follow a wound of a vessel caused by the trocar in tapping a hydrocele. The quantity and condition of the blood vary a good deal. Sometimes there is only sufficient to tinge the fluid, and to deprive it of its transparency. Oftener there are clots mingled with the fluid; sometimes it is pure blood. Occasionally the coagula are arranged in layers, as in an aneurismal sac;[1] and the blood may be in various stages of degeneration.

In hydrocele, as has been remarked before (p. 899), the containing tunic usually retains its tenuity and its transparency for a long time, and perhaps never alters. This is not so in hematocele. An early effect of the presence of the blood is to cause some inflammation and thickening of the tunic, whether it be the tunica vaginalis or the wall of a cyst. This thickening often proceeds to a considerable extent, amounting, it may be, to nearly an inch, and sometimes affects the surrounding areolar tissue, which becomes condensed and adherent to the tunic. In hematocele of the tunica vaginalis the thickening affects the visceral as well as the reflected portion of the tunic, and may extend to the tunica albuginea; but the substance of the testicle remains healthy, unless indeed it be subjected to atrophy in consequence of the pressure exerted upon it by the blood or by the contraction of the thickened tunics. Lymph also may be effused upon the internal surface of the tunica vaginalis and be, there, mingled with the clotted blood.

Diagnosis.—When the testicle becomes quickly swollen after a blow, the swelling not being caused by inflammation, which may usually be ascertained, there is probably hematocele. Or if a hydrocele suddenly enlarges and loses its transparency, there is probably an effusion of blood in its cavity. The probability is, in either case, increased by the presence of ecchymosis in the scrotum. But when the affection is more chronic, and when the ecchymosis, if it have existed, has passed away and been forgotten, the diagnosis is more difficult, and must be based upon a consideration of various circumstances, such as the degree of rapidity with which the swelling took place, the distinctness of fluctuation, and the history. None of these, however, are certain guides; and the records of surgery contain numerous instances of mistake under able hands—hematoceles removed for malignant disease, and malignant testes opened for hematocele, etc. Assistance may be derived from observing carefully the rate of increase from time to time. In cancer it usually goes on steadily; but in hematocele it is often irregular. Sometimes the hematocele ceases to enlarge, or even diminishes in size; and this seldom or never takes place in cancer. [An incision for purposes of exploration is in doubtful cases perfectly justifiable, and often offers the only reliable means of determining the character of the growth.]

[Fig. 502.

Hematocele of the vaginal tunic of the testicle (Gross).]

Treatment.—In ordinary cases of hematocele, especially when the affection is clearly attributable to a blow, the hemorrhage ceases after a time, the inflammation excited by it subsides, and the blood becomes slowly absorbed, the process occupying perhaps a long time, and being marked by the same stages as when blood is effused in other parts. Our first efforts, therefore, in the treatment of hematocele are to assuage the vascular activity and the inflammatory condition by rest in the recumbent position, with the scrotum elevated; by the local abstraction of blood by means of leeches placed above the scrotum [along the cord—leeches placed upon the scrotum are apt to be followed by extensive ecchymosis into the subcutaneous connective tissue, which is very loose and abundant]; and by cold or warm applications, according to the comfort afforded by them. [Ice or cloths dipped in ice-water, are decidedly the best local application in the early stage, *i. e.*, while the hemorrhage is continuing. Later, to promote absorption, the use of adhesive plaster as in epididymitis is one of the

tunica vaginalis between one and two inches in length, and covered with a coagulum."—Sir A. Cooper, On the Testis, p. 212. In a case where hydrocele was converted into hematocele by a blow from a hammer, Mr. Walter (Brit. Med. Journal, 1857, p. 524) found a rent in the tunica vaginalis, near the raphe, admitting the finger, and a ruptured artery from which the bleeding had proceeded.

[1] In the account of a specimen of this kind in Guy's Museum the patient is said to have had enlarged testicle from childhood.

most effectual remedies.] After the pain has been relieved and the heat of the part reduced, the patient may move about, with a suspensory bandage, and leave it to time to effect the remainder of the cure. Even when hematocele supervenes upon hydrocele the same treatment should be employed; and the gradual cure of both has, in some instances, followed, without any further surgical interference.

It sometimes happens, however, from causes which we cannot quite explain, that the hemorrhage continues; and the swelling, consequently, increases until it may contain some pounds of blood, the pain attendant upon it being proportionate to the rate at which it enlarges. The treatment mentioned in the last paragraph failing, a good-sized trocar should be introduced. If the blood is fluid, which it is sometimes found to be in these cases, great relief will often be afforded by its evacuation; and the diminution of the distension may be followed by a cessation of the hemorrhage; so that if the swelling returns, and a second tapping is required, the fluid will be thinner and more serous than on the first occasion. Should the accumulation continue, the case may be treated with injection of iodine, as in the case of simple hydrocele. The admixture of a certain quantity of blood with the fluid evacuated does not much lessen the prospect of success from that treatment. Sometimes, however, the blood is so far solidified that the trocar is of little avail. It may then be necessary to lay open the sac freely, to turn out the clots, and wash out the cavity by means of a syringe. The wound should be left open, to prevent further hemorrhage, and to permit an easy vent for the products of inflammation; suppuration and granulation will take place, and a cure may thus be effected. This proceeding is not unattended with danger; and, if the patient be advanced in life, it is safer to remove the entire mass with the testicle.

["Cases of old hematocele will occasionally be encountered in old persons, in which, from their size, the great thickness of the sac, and the unceasing irritation and pain experienced by the patient, it will be wiser to remove the testicle and the diseased vaginal tunic in their entirety, than to resort to either incision or excision of the sac." (Agnew.)]

This, however, is rarely necessary in young or middle-aged persons. One of the sources of danger is further hemorrhage from the tunica vaginalis, which has been known to take place profusely after the cavity has been laid open; or there may be severe and extensive inflammation, followed by sloughing of the tunica vaginalis and the tissues of the scrotum, with attendant fever and constitutional depression, which may prove fatal.[1] In some cases part of the thickened tunica vaginalis has been cut away with good result.[2] It has been said that when hematocele occurs spontaneously, it is more difficult of cure; but it is almost impossible to decide that the affection is really spontaneous, and not traumatic. Certainly the testicle ought not to be sacrificed, as would seem to have been done,[3] on the supposition that the affection was spontaneous.

The position of the testicle, under ordinary circumstances, is the same as in hydrocele; though I have observed that it varies more than it does in hydrocele. The gland is, therefore, commonly avoided by making the incision into the forepart of the swelling. In two cases mentioned by Mr. Curling there was inversion, the testicle being situated in front; and it was cut into in each. This led to its removal in one case. It is well, therefore, before using the knife or trocar, to endeavor to ascertain the position of the gland, by tracing the vas deferens and cord downwards, and making out whether they run to the anterior or to the hinder surface of the swelling; also by information derived from the sensations of the patient when pressure is made upon various parts. Obviously it must often be impossible to assure oneself upon the point.

Encysted hematocele.—Pathological collections present examples of cysts, both

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[1] Mr. Curling (On the Diseases of the Testis, p. 197) was summoned "to a gentleman aged seventy-nine, on account of an attack of retention of urine from enlargement of the prostate gland. He had also on the left side a chronic vaginal hematocele, which had attained so large a size as to interfere with the introduction of the catheter. The tumor reached half-way down the thighs, and the penis was so completely buried in it that I was unable to reach the glans at the navel-like orifice in the integuments to pass the catheter. I had no alternative, therefore, but to lay open the hematocele, from which three pints of dark grumous blood were discharged. The thickening of the sac prevented its collapsing after the incision. The patient died a week afterwards."

Sir B. Brodie does not recommend the negative treatment when the hematocele is of large size. Some artificial means should be resorted to for getting rid of it; first, because of its inconvenient bulk; and, secondly, because the pressure upon the testicle will disorganize, and in fact destroy, that organ. He found it to have been so in two cases dissected by him. Med. Gazette, vol. xiii., p. 380.

[2] Cooper's Surgical Dictionary, 8th ed., by Lane, art. "Hematocele."

[3] Lancet, 1860, vol. i., p. 191.

in contact with the testicle and in the spermatic cord, which contain blood; and cases of the kind are, now and then, met with in practice. They are not easy of diagnosis, the feature by which a cyst is most surely recognized—the transparency—being absent; and they are consequently liable to be mistaken for solid tumors, or for herniæ. [Fig. 503 represents an old hematocele which was removed under the impression that it was a solid growth of the testis—the sac and testis are laid open.] The defined round or oblong shape, the fluctuation, the connection with the cord, and the capability of being moved by traction made upon it, as in the case related at page 909, and the history, may assist in leading to a correct opinion. [These cases should be treated in the same manner as ordinary hematoceles.] Mr. Curling mentions a case in which twenty-four ounces of dark grumous blood were drawn by a trocar from an encysted hematocele.[1]

Fig. 503.

Hematocele of long standing (Curling).

[Hematocele of the cord may exist in the diffused form, and is due to the rupture of a spermatic vein, usually occurring as a result of violence or during muscular exertion with straining; in one case the tumor appeared immediately after sexual intercourse.]

[1] In the Sydenham Society's Year-Book of Surgery, 1861, p. 312, is quoted a case of hematocele of the tunica vaginalis, which ascended through the inguinal canal into the cavity of the abdomen. The treatment consisted in repeated tappings and injections of iodine.

Fibrous and Cartilaginous Bodies in the Cavity of the Tunica Vaginalis.

At the upper end of the testicle, or about the line of junction of the testicle with the epididymis, may usually be seen a small soft fibrous body projecting into the cavity of the tunica vaginalis and covered by the serous coat of the cavity. It may be a mere granule, or it may be a polypose, membranous substance of considerable size. So far as I have seen, it is relatively as large in young subjects as in older persons; that is, it does not seem disposed to grow disproportionately to the rest of the organ, and it is doubtful whether it even keeps pace with it. It is probably connected with the mode of development of the testicle, consisting, perhaps, of some of the more or less atrophied tubes of the Wolffian body, which have not become united with the gland, or a remnant of the thread or duct which descended from the testicle in the fœtus; and it would not deserve a notice in this place were it not sometimes mistaken for a tubercle or other morbid product. Moreover, as has been before mentioned, small cysts are occasionally found in it; and these, hanging pendulous into the cavity, may be a source of irritation to the tunic. There are also sometimes developed, at or near the same spot, small solid excrescences, at first warty, afterwards leaf-like and pendulous, which, like the cysts just mentioned, may be a source of irritation, and may lead to the formation of hydrocele.

Small *loose* bodies are also occasionally found in the cavity. There are commonly spherical, or nearly so, and are composed of laminæ of toughish fibrous, or fibro-cartilaginous, structure, with earthy matter at the middle. Their origin is involved in some obscurity in common with that of other bodies of the like kind, such as loose cartilages in joints and bursæ, phleboliths, etc. Probably they originate sometimes in the small fibrous processes just mentioned, or in cysts developed in them. These, increasing in size, becoming pedunculated, and then detached by giving way of the pedicle, and solidifying, might give rise to the bodies in question. This view derives confirmation from a case examined by Duplay:[1] one cartilaginous

[1] Archives générales de Médecine, 1855, vol. ii., p. 133. In the Museum at Fort Pitt, Chatham, is "a small pedunculated body of

body was loose in the cavity, and another was attached by a filiform pedicle to the head of the epididymis. They are sometimes found in hydroceles.

In a patient who used to suffer excessive pain as soon as the operation of drawing off the water was over, lying down on the floor and groaning with agony for a quarter of an hour, Sir B. Brodie found a loose cartilage after death in the cavity of the tunica vaginalis.

They may be recognized during life, and removed by an incision if they are a source of annoyance. Often they do not attract attention, and are discovered accidentally.

Lately, in examining the hydrocele of a man aged about fifty, which had recently been tapped, and which was rather flaccid from the fluid not having fully re-accumulated, I felt a firm smooth body slipping about in the cavity. I accordingly made a small incision, and extracted a disk as large as a bean, polished on the exterior, and composed of compact fibrous layers encircling an earthy nucleus. Hematocele ensued with intense pain, rendering it necessary to lay open the cavity fully. This hydrocele was of six months' duration, and had been twice tapped without there being any unusual pain or other symptom indicating the presence of a foreign body.

Other alterations in the tunica vaginalis, such as thickening and calcification, do not often occur, except in conjunction with hydrocele or hematocele.

Inflammation of the Testicle.

Under this head I propose to consider three affections: first, *acute inflammation;* secondly, *chronic inflammation*, including *syphilitic* disease; and thirdly, *scrofulous inflammation*. These are sufficiently distinct in their pathology, symptoms, and treatment to be discussed separately.

Acute inflammation is, comparatively, rare in the body of the testicle, but is very frequent in the epididymis. This is probably in some measure owing to the difference in the physical conditions of the two parts; the one being enclosed in a dense unyielding tunic which does not permit the phenomena of inflammation readily to take place; whereas the structure of the other is less compact and less supported by membranous investment. When the inflammation attacks the body of the testicle, the affection is called "orchitis;" when it attacks the epididymis, it is called "epididymitis," though the old term "hernia humoralis" is still often applied to it.

[It is important to recognize clearly the differential points between orchitis and epididymitis, although the two affections are not always distinguishable. In orchitis the swelling takes the general shape of the gland; in epididymitis it is elongated and lies on the posterior aspect of the testicle; in orchitis the pain is duller; the sense of weight is greater; the pain running up the line of the cord almost always found in epididymitis is absent in orchitis; acute hydrocele is common in epididymitis, rare in orchitis. See p. 916 (foot-note). The causes are different, orchitis resulting from constitutional conditions, such as rheumatism or gout, small pox, or syphilis, while epididymitis almost invariably follows a urethritis.]

Acute orchitis may be caused by a blow or a wound, but is most frequently seen during the occurrence, or rather during the subsidence, of mumps. It occurs in about one in forty or fifty of the sufferers from that malady; most often in those who are about the age of puberty. It begins usually on the fifth or sixth day of the affection, commonly in one testicle, sometimes in both. The glandular part of the testicle is more often involved than the epididymis; but the inflammation may commence in either part, and extend to the other. It reaches its height in four or six days, and then gradually subsides. It very rarely proceeds to suppuration, or any other structural change, or leaves any impairment of the organ. [It usually leaves the organ predisposed to subsequent attacks.] Now and then, however, it is followed by atrophy. Neither Sir A. Cooper nor Mr. Curling have met with this in their practice. Dr. Hamilton saw it in two cases; M. Rilliet in one.[1]

an ossific nature attached to the vaginal tunic covering the globus minor." In pl. xiii., fig. 2, of Sir A. Cooper's work, a cartilaginous body is represented hanging from the caput epididymis by its pedicle. Sir A. Cooper has also seen one of these little bodies pendulous from the internal surface of a cyst between the tunica vaginalis and the tunica albuginea. He never detected them in the living body.

[1] Dr. Hamilton, in Trans. of Royal Society of Edinburgh, gives an account of epidemics of mumps in Lyn, which appear to have been very severe, in 1758 and 1761. The testicles were acutely affected in several cases, and the brain in some. M. Rilliet observed an epidemic in Geneva in 1848 and 1849.

M. Beraud (Archives générales de Médecine, 5e série, vol. xiii., pp. 274 and 557) describes under the term "variolous orchitis," an inflammation of the testicle often occurring during variola. It affects occasionally the gland itself, but more frequently the tunica vaginalis and the epididymis; is attended with plastic deposit in the latter, and with

I was lately consulted by a gentleman who attributed the wasting of one testicle to an attack of inflammation, during mumps, when he was a boy. The organ was almost gone, the vas deferens terminating only in a small lump, which was tender.

Although both testicles are sometimes inflamed in mumps, I am not aware of any instance in which atrophy has followed in both. The possibility, however, of this sequence in both organs, and its occasional occurrence in one, should induce us not to neglect the ordinary means of mitigating the inflammation when it supervenes, such as rest, cooling lotions, and saline aperients. It is not necessary, or wise, to resort to more active measures, unless the inflammation be very severe. Orchitis is also an occasional attendant on rheumatism.

I do not remember to have seen a case of simple acute orchitis—that is, an acute inflammation of the substance of the gland—unless it were caused by a blow, or associated with mumps or some urethral irritation. Nor do I meet with a clear description of it in surgical writings. Still it is most probable that it does sometimes happen. [I have seen one case in a gentleman of seventy-three years of age, following an attack of gout in the great toe and unassociated with urethral irritation. It subsided under anodyne lotions and the internal administration of iodide of potassium and colchicum.]

In the Museum of the St. George's Hospital is an example of "purulent deposits in the testicle in combination with synovitis;" but this was in a case of pyæmia. Mr. Ludlow has recorded a case, under the care of Mr. Stanley, in which acute inflammation of the body of the testicle in a feeble person (a sufferer from stricture), went on to suppuration and gangrene of a portion of the glandular substance.[1]

In infants.—Mr. Curling mentions some cases of inflammation attacking the testis of young infants. The symptoms were acute, and the swelling was considerable; but the disease soon subsided, and was always confined to one testis. I have seen similar cases. The testis was very hard, and I judged that the inflammation was seated in the body of the gland. I could not discover any especial cause for the affection.

Epididymitis.—The exciting causes of epididymitis are injuries to the organ from pressure, blows, etc., and some irritation in the urethra, more particularly in the part of the urethra contiguous to the orifices of the seminal ducts. Thus the affection sometimes follows lithotomy; the impaction in, or the passage of calculi through, the urethra; stricture of the urethra, or the introduction of instruments for the relief of stricture or for other causes; and, above all, the inflammation of the urethra attendant upon gonorrhœa. It may also occur spontaneously in persons of rheumatic or gouty diathesis, and in other persons.

[The left testicle is usually affected nearly twice as often as the right. This is commonly attributed to the fact that as a rule it hangs lower, and thus receives less support from the scrotum. It is more probably, however, the result of the position of the left spermatic vein behind the sigmoid flexure, where it is especially subject to obstruction by pressure, and also of its indirect communication with the vena cava through the renal vein, which it enters at a right angle, the right spermatic vein emptying into the cava at an acute angle. The left spermatic vein is also unprovided with a valve at the point of entrance into the renal vein. These causes, which are believed to cause the frequency of varicocele in the left side, are also sufficient to produce local congestion, a powerful predisposing cause of inflammatory attacks.]

In the acute stage of gonorrhœa pains are often felt in the testicle, accompanied by soreness; but these seldom are the immediate precursors of anything further. They subside as the severity of the urethral affection abates; and the inflammation of the testicle does not commonly supervene till a later stage, when, perhaps, discharge is the only remaining symptom of the gonorrhœa. [It commonly occurs from the sixth to the tenth week.] It may be induced, then, by slight causes, such as much exercise, especially on horseback, or by tight trousers. So long as the discharge lingers, so long is the patient liable to swelled testicle; and those measures are most preventive of the latter affection which most quickly put an end to the former. The sudden suppression of urethral discharge may, now and then, by a sort of metas-

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the effusion of serum and fibrinous matter into the cavity of the tunica vaginalis.

"Epidemic catarrhal orchitis." In a recent epidemic of catarrhal fever described by M. Desbarreaux-Bernard, of Toulouse, to which the prevalence of mumps imparted a special character, the inflammation of the testis appeared at once in several patients without any preliminary affection of the parotid whatever.—Med. Times and Gaz., vol. xix., p. 512.

[1] See cases of partial gangrene of the testis, Med. Times and Gazette, vol. x., p. 338; vol. xiii., pp. 568 and 631.

Mr. Paget has "a specimen in which extensive deposits of lymph and pus are seen in the testicle of a man in whose urethra a portion of calculus was impacted after lithotrity."

tasis, induce inflammation of the testicle; but this is so rare an event that the apprehension of it need not influence our treatment of gonorrhœa. It has been supposed to be more common than it really is, because the onset of the inflammation in the testicle is generally, though by no means always, attended with a diminution of the discharge from the urethra; and cause and effect have been often confounded. That the affection of the testicle is rather the cause than the effect of the subsidence of the urethral inflammation is proved by the fact that it is very commonly excited by some injury; and, moreover, when it subsides, the urethral affection usually reappears. There is no evidence, in the greater number of cases, that the inflammation travels along the vas deferens from the urethra to the testicle. I do not know that we can offer any other explanation of its occurrence than is conveyed by the term "sympathetic."

[The facts that the usual premonitory symptoms indicate involvement of the vas deferens; that the disease develops so late in the course of attacks of urethritis, and that actual inflammatory changes have been observed in so many instances through the entire canal between the urethra and the testicle, seem to me sufficient to demonstrate that there is no mystery about the occurrence of the epididymitis, but that it is due to the commonest mode of extension of inflammation—*i. e.*, by continuity of tissue. Berg found unmistakable evidence of inflammatory changes in 182 cases out of 346—more than fifty per cent. It is not to be expected that in every case the effects on the vas deferens would be apparent.]

The course and symptoms of the inflammation are much the same whether it accompany gonorrhœa or other irritation of the urethra, or be excited by some other cause. The epididymis is the part first and chiefly affected. Attention is attracted to the malady by pain which, after a time, is felt not only in the scrotum but in the groin, the iliac region, and in the loins.

[The earliest symptom is often a pain in the groin, which I have seen transmitted to the buttocks and perineum, and down the anterior surface of the thigh along the course of the crural nerve, and which is sometimes so severe that the commencing enlargement of the testicle is not noticed by the patient until his attention is directed to it. The reflex neuralgia of epididymitis may extend to the whole of the lumbar region on both sides of the body, may involve the sciatic as well as the crural nerves, and sometimes even the intercostals.]

The testicle is tender; one end, usually the lower, of the epididymis is enlarged and very tender; and the vas deferens may also be thickened and tender. The whole of the epididymis soon becomes involved, serum and lymph being infiltrated in the cellular tissue between the convolutions of its tubes, so as to form an elongated mass at the back of the testicle; and the swelling is much increased by the effusion of fluid mixed with lymph into the cavity of the tunica vaginalis[1] and into the loose tissue of the scrotum. The skin also is inflamed. The pain is often very severe—especially in the early stages—dull, heavy, sickening. The bowels are generally constipated, and the patient is feverish and sick. The constipation and sickness have, in some cases, been so obstinate as to cause apprehension of hernia. The inflammation rarely proceeds to disorganization of the tissue, or even to suppuration. It generally subsides in a few days, leaving fluid and lymph in the tunica vaginalis and the epididymis enlarged and hardened. These remnants gradually disappear, and the organ resumes its natural size; and its function is in great measure restored, though this, for obvious reasons, is not easily ascertained with certainty. Such at least is the usual course, even when not modified by treatment. I have seen many cases which have been left without treatment, or even rest; but I do not remember any, where the inflammation was of a simple kind and in a healthy subject, which did not terminate in resolution, or any in which atrophy of the organ was clearly traceable to this cause.

Sometimes when the inflammation has continued for a long time, the tubes become thickened and dilated, just as we find in the case of the ducts of the kidney and other organs when they have been the subject of chronic inflammation. [Terrillon found after experimenting upon dogs, that the swelling of the epididymis does not correspond with its external appearance. It seldom enlarges to double its size, and what is felt is usually the induration of the neighboring tissues.] These changes are dependent partly upon

[1] The extension of inflammation from the epididymis to the tunica vaginalis, and *vice versâ*, takes place more readily than from the testicle, because the areolar tissue of the epididymis, which tissue is usually attacked by the inflammation, is in close contact with the tunica vaginalis—indeed is continuous with the attached strata of that tunic; whereas the areolar tissue of the testis is inclosed by the thick fibrous tunica albuginea, which separates it from the tunica vaginalis, and acts as a barrier against the passage of inflammation to and fro. The fluid in the cavity of the tunica vaginalis sometimes amounts to several ounces in these cases.

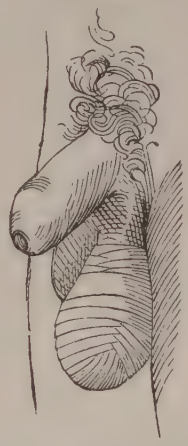
the direct effects of the inflammation, and partly upon distension from the secretion not finding a ready passage. They are not necessarily persistent; for, if the inflammation subsides, the tubes may gradually resume nearly, or entirely, their natural calibre. Occasionally the dilatation of the tubes is caused by seminal engorgement, consequent on obstruction or obliteration of some of them, as described by M. Gosselin.[1]

I have said that the epididymis is the part first and chiefly affected; but if the inflammation be very severe or long continued, it is liable to extend to the body of the testicle. At least such is the opinion of several pathologists;[2] and it is probable that it does so. It is certain, however, that it rarely proceeds to any great extent there, or causes much alteration in the tissue.

Treatment.—It is not usually necessary to adopt any severe plan of treatment. Now and then the disease may be arrested in its initiatory stage (that is, when the inflammation is commencing in one part of the epididymis) by well-adjusted pressure with plaster and bandage, or by antimony freely given, or by pressure and antimony combined. [I do not believe this is ever possible.] But the pressure often cannot be borne; and antimony, in large doses, though it sometimes causes a marked alleviation of the symptoms, not unfrequently tells more upon the patient than upon the malady.

[Rest in bed, leeches to the cord, the application of a mixture of aconite, laudanum, and lead-water, and the exhibition of an ordinary anodyne and febrifuge mixture, bring relief in a few days to the majority of cases. When the cold application is unpleasant, the same mixture may be used hot, or a poultice may be made of flaxseed and fine-cut tobacco mixed with hot water and laudanum. As soon as the acute pain subsides, and while the patient is still unable to walk with comfort, compression should be applied to the testicle, as follows: the scrotum is shaved, the testicle drawn down as far as possible, and a strip of adhesive plaster, half an inch in width, placed circularly above it, so as to retain it in that position, where it forms a tense pyriform tumor. This is then covered in tightly by successive strips of plaster, placed first horizontally, each overlapping a portion of the preceding one, and finally vertically, so as to cover in the lower surface. It is

Fig. 504.



Strapping of the testicle (Gross).

then placed in a suspensory bandage, and in a vast majority of cases the patient is able at once to resume his usual occupations with little or no pain.

This dressing should be replaced every twenty-four or forty-eight hours, as it will become loose as the swelling beneath it subsides. An ointment of belladonna and iodoform may then be substituted, and kept in contact with the scrotum beneath the suspensory bandage. Blaschko has used Esmarch's bandage as the compressing agent, and reports good results; but the amount of force exerted by its means is always uncertain, and might be dangerous.]

Leeches, especially if they be placed upon the scrotum, certainly increase the external swelling and inflammation;

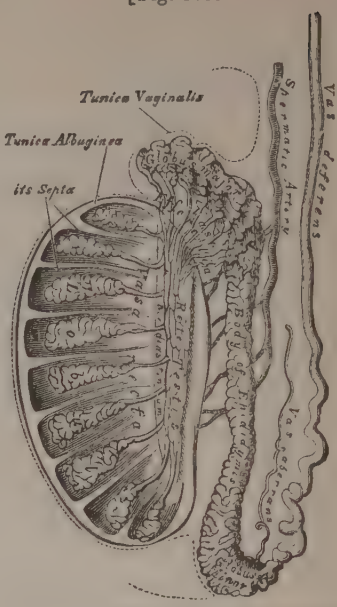
[1] Archives générales de Médecine, 4e série, vol. xiv., p. 405, vol. xv., p. 40. This author made several dissections where the tubes of the epididymis or the vas deferens were impermeable and transformed into fibrous or other structure; and it is worthy of remark that in none of them was there any atrophy of the substance of the testis. In some the tubes below the obstruction were dilated; in some, they retained their natural size. The vesiculæ seminales were of natural size in all the instances in which they were examined. The cause which led to the obstruction, whether it were inflammation or not, was uncertain in each of the cases; but we learn from these observations that the absence of atrophy after an inflammatory attack is not certain evidence that the function of the organ is capable of being performed; which is in accordance with the observations and experiments at p. 893. Mr. Curling says that in only two cases where the epididymis had suffered from inflammation had he remarked a decidedly atrophied condition of the organ. He speaks of suppuration occasionally taking place.

[2] Velpeau, in Dict. de Méd.; Demme, in Virchow's Archiv, vol. xxii., p. 177; a writer in Brit. and For. Med. Rev., vol. xvii., p. 76.

In the Edinb. Med. Journ., vol. vi., p. 455, is a case of acute suppuration and hernia testis supervening upon gonorrhœa.

and their beneficial effect upon the testicle is often questionable. If they be placed above the scrotum, in the course of the cord, they do as much good and are productive of less annoyance. I have never tried the plan of opening the veins in the scrotum. Rest in the recumbent position; mercurial and saline aperients; antimony, given so as to produce and maintain nausea, and combined with small doses of mercury; with a spirit-lotion applied upon a soft folded rag, beneath a handkerchief so arranged as to support the part, and prevent it hanging between the thighs and to keep it moist, seem to moderate the severity of the malady as much as sharper measures, and do little or no harm to the patient. It is very rarely advisable to give opium, and seldom necessary to affect the system decidedly with mercury. Mr. Watson[1] has found relief afforded by the plan, proposed by Vidal de Cassis, of puncturing the testicle during the acute stage. The relief was greatest when fluid was evacuated by the puncture from the tunica vaginalis. [The plan proposed by Vidal de Cassis was to puncture the tunica albuginea. This has been followed in a number of cases by hernia of the tubuli seminiferi, and occasionally by destruction of the organ. In those instances in which the pain is very severe and resists the remedies already mentioned, a careful incision or puncture extending only into the distended cavity of the tunica vaginalis, and evacuating the contained fluid, will give great relief, and is unattended by danger.] If the induration and enlargement of the epididymis linger more than usual, they may be reduced by pressure with plaster and bandage, or by iodine and mercurial ointment combined and rubbed upon the scrotum so as to produce slight irritation of the skin. It is important to secure the restoration of the part to a natural condition as soon as possible; forasmuch as the observations of MM. Gosselin[2] and Godard indicate that a thickened indurated state of the upper or lower end of the epididymis often prevents the passage of the secretion of the testicle to the vas deferens [almost invariably the lower, upon which the pressure of the fibrous exudation is the more effective, as the globus minor consists of a single tube, obliteration of which at any one point would be sufficient to prevent the exit of spermatozoa from the secreting portion of the testicle]; and that so long as it remains, though there may be all the signs of virility, with desire and power of copulation and emission, there is likely to be no impregnation, in consequence of the absence of spermatozoa in the fluid emitted.[1]

[Fig. 505.



Vertical section of the testis and epididymis (after Gray).]

[1] Med. Times and Gazette, vol. xxxii., 520, and vol. xxxiv., 390.

[2] Archives générales de Médecine, 5e série, vol. ii., p. 257.

[1] See obs. confirmatory of that view by Mr. Curling, Brit. and For. Med.-Ch. Rev., April, 1864.

M. Liégeois (Med. Times and Gazette, Sept. 25, 1869, p. 381) has examined 28 cases of bilateral epididymitis at various periods after the attack, and found spermatozoa in only seven; of these the affection in five was from accidental causes, *i. e.*, not from gonorrhœa. And he accordingly makes a distinction in this respect between the *external* epididymitis and the blenorrhagic or *internal* (that is, commencing in the interior of the tube), believing that the latter is much more likely to interfere with the passage of the semen. "These numbers speak for themselves; they will suggest to every one the importance of the antiphlogistic treatment, the necessity of calming the inflammatory element, on the intensity of which seems to depend the danger of definitely obliterating the excretory duct of the seminal fluid." All the other elements may be present without the spermatozoa, showing that they are furnished by the seminal vesicles or prostate. M. Liégeois even affirms that in unilateral epididymitis the secretion of the opposite testicle is diminished at the time and long afterwards (loc. cit., p. 513 and 541), thus indicating a difference between the testicles and other double organs "which naturally support themselves, and redouble their energy when the function of one of the two is impaired."

[Induration of the epididymis or pressure upon it is of course much more effectual in preventing the exit of spermatozoa than an equal involvement of any other portion of the testicle, as the vasa efferentia have here united into one tube, the lumen of which being occluded no other possible mode of escape remains.]

If the fluid in the tunica vaginalis remains, after the induration and swelling of the epididymis are gone, it may be treated as a case of ordinary hydrocele.

Sometimes the affection is prolonged, or recurrences of inflammation are induced, by the presence of a stricture or other source of irritation in the urethra; and when this is removed, the testicle usually soon regains its natural state under appropriate management. In the treatment of obstinate or recurrent epididymitis it is, therefore, well to examine the condition of the urethra by passing a bougie. Such cases should not be neglected, because, as just pointed out, the tubes of the part are liable to be impaired or destroyed by the effusion of lymph and other effects of protracted inflammation.

[There is a form of epididymitis which is due to syphilis, and was first described by Dron some twenty years ago. It is very rare, comes on during the early months, attacks the globus major instead of the globus minor, is indolent and almost painless, never suppurates, and disappears rapidly under constitutional treatment; no local measures are required. Bassereau, Rollet, and Lancereaux have all reported cases.]

Chronic inflammation, including syphilitic disease.—Chronic inflammation of the testicle is seldom a relic of acute inflammation. It may be due to stricture of the urethra, or to injury; but the most common cause is syphilis; and the following account is drawn chiefly from the observation of that form of the disease. It usually occurs in what is called the tertiary stage of syphilis; the most frequent concomitant symptoms being inflammation of the bones and ulceration of the skin and throat; or it may occur alone, without any other secondary or tertiary symptoms; or it may commence after these have subsided. It is most frequent in those who are pale and feeble.

The inflammation is often insidious, and may at first be unattended with pain and confined to a part of the organ. The patient, perhaps, accidentally discovers that one or both of his testicles are enlarged and hard, or that some part of one or both is in this condition; and he may not be aware of the presence of any such disease till it has made considerable advance. The surgeon should, therefore, examine the organs in suspicious cases; indeed, in all cases of tertiary syphilis it is well to do so. Occasionally it is met with as a congenital affection in infants.[1]

Pathology.—The structure chiefly affected is the areolar and septal tissue of the gland, as well as the tunica albuginea, and the mediastinum; and less frequently the areolar tissue of the epididymis. These tissues become indurated by the deposition of lymph into their substance, causing enlargement, hardness, and heaviness of the organ; and the deposit often takes place irregularly, affecting some of the lobules and not others, or affecting them unequally.

The knotty outline of the testicle, which, when present, is very characteristic of this disease, depends also partly, and in some instances entirely, upon another cause besides the unequal manner in which the lobes are affected, and that is, upon a deposit of lymph, or plastic material, in nodules or tubercles, in or upon the tunica albuginea, or in the areolar tissue of the testis. These nodules are sometimes very dense; they have commonly a whitish or faint yellowish-white color, and are sparingly streaked with bloodvessels, which exist in greater numbers at their circumference; and they are described, by those who have examined them microscopically, to consist chiefly of fine nucleated fibres, and to show a tendency to oily degeneration towards the centre.[2]

If the disease subsides in an early stage, the lymph may be nearly or quite absorbed, leaving the tissue little impaired. If the lymph be more abundant, or be more organized, it is likely to remain, causing thickening and opacity of the septa and gradual contraction of them; and this contraction, as in cirrhosis of the liver, is attended with shrinking and wasting of the glandular substance. In this way, atrophy of the testicle, more or less complete, may be brought about. The disease in that stage is well illustrated by specimens (2351, [56, 57, 58]) in Guy's Hospital Museum, which are described as examples of "fibroid degeneration of the testicle," and are attributed to syphilis. In these specimens the glandular tissue is seen to have in great measure disappeared, being replaced by opaque white fibrous tissue, diffused and in nodules, which bears all the appearance of having been the product of inflammation. Both testicles are affected in a nearly equal degree in each of the three cases. The intermediate or remaining glandular parts appear to be sound, also the vas deferens and the epididymis.

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[1] Path. Trans., vol. xvi., p. 189.

[2] Virchow, in his Archiv, vol. xv., p. 263; and Demme, in Virchow's Archiv, vol. xxii., p. 181.

Sometimes, however, perhaps usually when the disease is long continued, the inflammation extends to the tubules, the walls of which become thickened and blended with the intervening tissue, according to Virchow,[1] while the epithelium lining them undergoes pigmental and fatty degeneration.[2]

Not long ago, examining a patient who died from other causes, I found both testes of about the natural size, hard and knotty, with the glandular structure almost obliterated, its place being occupied by a mass of firm indurated tissue like old organized lymph, except at one point where the natural structure appeared quite sound. There was no history in this case, but it was probably one of syphilitic disease. In some cases the gland-tissue is so entirely supplanted by fibroid tissue, and the symptoms that have attended the change have been so slight, as to suggest that it was a result, not of orchitis, but rather of a degeneration.[3]

[" The body of the testicle, which is commonly alone affected, is somewhat increased in size, but never to the same extent as in encephaloid disease of the same organ; and it rarely exceeds twice its normal diameter. Ricord was in the habit of saying at his lectures, 'Whenever you meet with a tumor of the testis as large as your fist, and find that the swelling is not in a great measure due to effusion, you need not suspect syphilis.' " (Bumstead.)]

M. Vidal (de Cassis)[4] lays great stress on the tendency to atrophy of the syphilitic testis. He gives, however, instances of the recovery of function in testicles which had been severely invaded by syphilitic inflammation.

A testicle which has been hard and knotty from chronic inflammation may remain in that state for years, undergoing very little change and being a source of little or no inconvenience. It may even, to some extent, perform its function. Under such circumstances the patient is not usually willing to submit to treatment; and if it be clear that the disease is not progressing, it is scarcely worth while to interfere; for the effused lymph, which is the cause of the hardness, has probably acquired such consistency that it will not become absorbed, except under the influence of means which may injure the health or do damage to the remaining tissue of the organ.

The disease is sometimes, though not very often, accompanied by effusion of fluid into the cavity of the tunica vaginalis. When it is so, we cannot judge of the condition of the testicle till the fluid has been evacuated.

By most authors this disease—"syphilitic sarcocele," as it is sometimes called—is not sufficiently distinguished from the scrofulous disease—scrofulous or "tuberculous sarcocele"—to be presently described. Yet there are very considerable and important differences between the two in their causes, their nature, and their treatment, as well as in the tissues primarily affected by them. The chronic inflammatory disease does not often originate spontaneously, but is due to a blow, to a source of irritation in the urethra, or to syphilis; whereas the scrofulous disease is not usually traceable to these causes, but is dependent upon the scrofulous diathesis. The morbid product, in the one instance, is situated primarily and commonly in the connective tissue, and has a tendency to fibrous development; in the other it exists primarily and chiefly in the tubules, though tubercles are sometimes developed in the connective tissue, and it has more the molecular or cell form, with tendency to oily, or caseous, or earthy, or more frequently purulent degeneration. The one disease may require antiphlogistic treatment, and yields more readily to mercury and iodide of potassium than to any other means; the other is rarely benefited by depletion or mercury, but requires measures directed to promote the general health. Both, however, are liable to suppuration, and the subsequent protrusion of the glandular substance in the form of "hernia testis;" and this has probably led to the two diseases being confounded together. [Suppuration, fistulæ, and fungous outgrowths, or hernia testis, are all rare in syphilitic orchitis. They are common in inflammation of the testicle following injuries, and in tubercular or scrofulous orchitis.]

Suppuration.—The inflammation sometimes goes on to suppuration, the pus

[1] Archiv, vol. xv., p. 264.

[2] "The coni vasculosi become thickened, hardened, and of a dark brown color." "In general there are marks of inflammation upon the tunics of the testis, such as, for example, adhesion; the substance of the gland itself is changed, the septa are much more apparent than natural, the seminiferous tubes appear to be less in number, are undoubtedly much reduced in their size, and many become cords instead of tubes." "The absorption may proceed till the whole of the glandular structure of the organ is removed, leaving the tunica vaginalis adherent to the tunica albuginea and the septa within the latter; but the whole substance which remains is not larger than the extremity of the finger, and it feels a firm and very solid body."—Sir A. Cooper, On the Testicle, pp. 23, 24.

[3] Dr. Wilks, at Path. Society, Lancet, 1859, vol. i., p. 538.

[4] Mém. de la Société de Chirurgie de Paris, vol. ii., p. 92.

being formed in the substance of the testis, and being, consequently, bound in by the tunica albuginea. Supposing it to be formed only at one or two points and in small quantity, it may remain for a great length of time in the testicle; and becoming surrounded by a thick wall of lymph, it may dry up into a caseous or putty-like substance, or be the seat of calcareous infiltration, and so be ultimately converted into an earthy mass. Small abscesses in these stages of decline are not unfrequently met with in the testicle, and occasionally are symmetrical in the two testicles. They are commonly thought to be of tuberculous origin, and probably are so sometimes. It now and then happens that a small collection of pus pent up in the testicle is a source of a good deal of irritation, and gives rise to frequently recurring attacks of inflammation. In the Museum of the College of Surgeons is a testicle with a small abscess in the epididymis; it was extirpated because it had for many years been the seat of the most severe pain.

When once matter is formed, however, it generally increases, as in the case of abscesses in other parts, and distends the tunica albuginea and other tissues of the testicle. It thus induces absorption, to a greater or less extent, of the glandular tissue, and gradually makes its way through the tunica albuginea, most commonly through the fore part. The tunica vaginalis becomes adherent; so do the superficial structures, and the matter is in course of time discharged through them. The aperture may continue for a time, and then close, the disease abating; or a succession of abscesses may form, burst, and heal.

Hernia testis. — Sometimes, however, healing does not take place so favorably. The aperture in the skin is enlarged by ulceration, and discloses a firm coarsely granular mass connected with the testicle. The mass might be supposed, even when removed from the body, to be formed by granulations sprouting from the anterior surface of the testicle; a section, however, almost always shows that it is composed, as first pointed out by Sir W. Lawrence,[1] of the indurated and altered structure of the testicle, pressed through the ulcerated opening in the tunica vaginalis, constricted where it is girt by the tunic, and expanding and granulating beyond it. It is seldom large, and the testicle has usually become much reduced in size when the protrusion takes place; so that altogether the protruding mass and the remnant of testicle often do not more than equal the natural size of the organ. The amount of the protrusion varies from a small nodule to the whole substance of the testicle. In some cases the entire glandular part of the testicle, and with it the mediastinum, is projected through the tunica albuginea, and stands out beyond the level of the skin; and even then, as just said, the protruding mass is not very large.

The integuments around the hernial protrusion are usually indurated, and more or less undermined. Sometimes they constrict its neck like a collar. Sometimes they are ulcerated as well as indurated, the ulcers spreading with everted edges and very painful, so that the disease presents many of the characters of cancer. In a case lately under my care the affection was thought to be malignant, and had much that appearance; but under mercurial inunction the protruding mass shrank and the ulcers healed.

In this disease, whether the epididymis be implicated or not, the vas deferens is not usually diseased. In all the cases that I have examined, though some were of long standing and far advanced, that tube retained nearly or quite its natural size, and so far as I could judge, its natural condition. Nevertheless M. Liégeois finds that the seminal fluid is usually deprived of spermatozoa when the affection is double; but they may re-appear, and often do so under the influence of iodine.[1]

Diagnosis. — The pain attendant on chronic inflammation of the testicles varies with the rate at which the disease progresses. When this is slow, there is often no pain at all, or merely an uneasiness which may not be constant. Indeed, as before said, the patient may be first apprised of the malady by finding one or both testicles larger than natural. When the testicle swells more quickly, the pain is often severe, dull, heavy, aching, extending to the loins. Sometimes it is perceived only in the loins. When matter is forming there is usually pain; though this also depends upon whether it forms quickly or not. The enlargement of the testicle from chronic inflammation may be distinguished from that dependent on other causes by its appearing first in the body of the testicle, and by the uneven, knotty feel, or stony hardness of the gland. The part is usually tender, and more or less painful. It rarely attains to any great size. The distinction between testicle and epididymis is soon lost; perhaps the latter becomes involved in the disease; and too frequently, both testicles are affected, the disease probably showing itself at corresponding parts of the two organs. The presence or history of syphilitic disease in other parts of the body will further assist in the diagnosis.

[1] Edinb. Med. and Surg. Journal, vol. iv., p. 257.

[1] Med. Times and Gazette, Nov. 6, 1869, p. 541.

If there be hydrocele superadded, it may be impossible to recognize the condition of the testicle till the fluid has been evacuated.

Treatment.—The greater tendency of chronic inflammation, as compared with the acute form of the disorder, to show itself in both testicles, and to impair or destroy the glandular tissue of the organs, renders its treatment very important. It is also a more complicated and difficult matter than the treatment of acute inflammation of the testicle; for not only is chronic inflammation, under most circumstances, a more obstinate and less amenable affection than the acute, but in this case it is, in addition, often associated with, and dependent upon, a constitutional malady which requires very much patience and good management for its control. The local treatment is such as is suited to chronic inflammation of other parts:—rest, and support by means of a suspensory bandage, with perhaps the more decided pressure of an elastic bandage or of plaster. Well-adjusted pressure is an effective means of reducing the size of a testicle enlarged by inflammation. It is not of much service—indeed, it usually cannot be borne—when suppuration has commenced. Hydrocele, in addition to the enlargement, facilitates the employment of pressure; and I have remarked, that the fluid does not so easily disappear under its influence as does the more solid swelling of the testicle. The pressure may be alternated or combined with the application of iodine and mercurial ointment; or the latter may be employed alone, for a great number of cases of chronic enlargement of the testicle will be found to yield to its influence. Leeches are sometimes of service. The best plan is to apply a few, three or four, upon the scrotum—the objections to placing them on the scrotum, mentioned when speaking of acute inflammation, not holding good in the case of chronic inflammation; and they may be repeated two or three times a week.

Attention to the general health forms a most important item in the treatment of most chronic inflammatory affections; but the directions must be regulated according to circumstances; and I simply allude to it here for the purpose of indicating that it must not be forgotten.

When suppuration has taken place the abscess should be opened early; and the opening should be maintained so as to ensure a free vent for the matter. If a sinus remains long, after either the artificial or the natural opening of the abscess, it may be laid open and cauterized to the bottom. When the granular substance of the organ protrudes, forming what is called "hernia testis," a cure may often be effected by pressure with plaster carefully and perseveringly applied. The plaster should be renewed at least once daily, in some instances twice a day. It is well to leave an hour or two between the removal and the re-application of the plaster, during which time the surface can be well cleansed and refreshed. Some lint or charpie, with nitric oxide of mercury, or some stimulating fluid, may be placed upon the granulating mass beneath the plaster. If this plan fails, or is likely to fail, the protruding part may be removed with the knife or caustic; or, which is a better plan, the undermined skin may be divided, and all sinuses freely laid open, even if they extend into the substance of the testicle. The edges of the skin should then be pared away; and the skin having been separated from the testicle on either side, its edges are to be united in front of the testicle by suture, as suggested by Professor Syme. It may be desirable to remove the protruding part before approximating the edges of the skin, as practised by Sir A. Cooper: this, however, is not often necessary; for the granular mass, when it is covered by the skin, sometimes shrinks, and gives no further trouble. If the union of the skin fails, and suppuration takes place beneath it, and the granular mass reappears, a cure is still not necessarily to be despaired of; and it may be promoted by attention to the general health, and by stimulating applications or pressure. I have also heard of an operation performed in Glasgow, and devised by Dr. Pagan of that city, which consists in dissecting down methodically to the tunica albuginea, and then incising the margin of the aperture in that tunic like the ring in a strangulated hernia. After this the treatment of the affection is said to be much more successful. We should be unwilling to remove the organ, because, even in the very worst cases, a sufficient amount of glandular structure sometimes remains so far unimpaired as to perform its function or to admit of being restored for that purpose. It may, however, be desirable to resort to this measure if one testicle only is involved, when the disease in it has been extensive, and when the state of the patient's health requires a speedy relief from the local source of irritation.

When the chronic inflammation of the testicle is part of a syphilitic affection, which is very often the case, the treatment must be conducted in accordance with the principles laid down in the essay on SYPHILIS. I will only here remark that the plan which I have found most effectual, indeed rarely to fail, in chronic orchitis, whether there be a syphilitic history or not, if commenced before suppuration has taken place, is the rubbing in of mercu-

rial ointment. A small quantity is to be rubbed into the scrotum, or any other part of the body, once or twice a day. It is scarcely necessary to carry the mercurial influence upon the system to such an extent as to affect the gums. Small doses of the iodide of potassium may be given at the same time; and the decoction of sarsaparilla, made fresh and taken to the amount of a pint or a pint and a half daily, is very beneficial when the patient is debilitated. In this and other syphilitic affections the mercurial infrication has, so far as my observation goes, proved more effectual than the fumigation or bath; and, with a little care in varying the place of its application, the irritation of the skin liable to follow its use may be avoided. Even when suppuration has taken place, the mercurial influence may be beneficial in promoting the removal of the effused lymph, and, occasionally, in determining the absorption of the pus.

[If the case should be of a doubtful character, and an operation be contemplated, it is well to recall the rule laid down by Van Buren: "In all cases of doubt, with enlargement of the testicle, never operate until a thorough anti-syphilitic treatment has been tried faithfully, including large doses of the iodide of potassium."]

In syphilitic cases I have known the ulcers of the skin, consequent on the bursting of abscess formed in the testicle, and accompanying the hernial protrusion, to spread quickly with foul surface and sinuous edge, and to be attended with great pain. Under the use of opium, combined with other measures for supporting the skin, so as to relieve it of the pressure of the testicle, and for reducing the size of the testicle, this serious aggravation of the malady may be overcome.

Those measures which most tend to arrest the disease, and promote the removal of the effused lymph, are the most calculated to prevent the atrophy which is liable to ensue upon chronic inflammation of the glandular structure of the testis. The atrophy may commence during the swollen state of the organ; indeed, atrophy and enlargement may go on together. We do not, however, obtain evidence of the former till the swelling subsides. We then find that the diminution does not stop when the organ is reduced to its normal size, but continues, and may go on till the testicle almost entirely disappears. I do not know that any means can be adopted which give much hope of staying the progress of atrophy. An invigorating plan should be pursued—fresh air, cold ablutions, nutritious diet, etc.

A recurrence of the disease—and this has been found to take place in several instances—is best prevented by continuing the mercurial influence, in a slight degree, for some time after the testicle has resumed its natural state. This treatment should be combined with a general tonic regimen and measures calculated to promote the general health. The compound decoction of sarsaparilla certainly has a beneficial effect in these cases.

I have thought it best to consider syphilitic orchitis in conjunction with common chronic orchitis, because the two affections correspond closely in nearly every particular. The symptoms and course of the two are the same. Their pathology, so far as we can judge from external examination, is the same. There is the hard knotty enlargement, commencing usually in the body of the testicle, but affecting often the epididymis; there is the tendency to suppuration, to hernia testis, and to atrophy. [These tendencies do *not*, in my opinion, characterize syphilitic orchitis. Ricord indeed taught that suppuration never took place in this disease, and that when it seemed to occur in such cases it was due to gummata of the subcutaneous tissue.] And this view of the pathological relationship is confirmed by the few opportunities which have been afforded of examining syphilitic testes in the early stage of the disease. The treatment is the same; the only difference being that where a syphilitic virus is present, the tendency to recurrence of the disease is greater, and the remedies must, consequently, be more perseveringly continued. Lastly, and this is not the least important reason, the two affections can be distinguished only by the history, or by the presence or absence of other symptoms; and it is probable, if not certain, that many—I would say most—of the cases supposed to be examples of simple orchitis are, in reality, the result of syphilitic disease.

Chronic orchitis is sometimes met with in one or both testicles in infants, the part being enlarged and hard, and perhaps tender. In some cases it has been attributable to syphilis; and it generally yields to mild mercurial treatment.

Scrofulous or tuberculous disease is one of the most common affections of the testicle—more common than is generally supposed. It is most frequent in young men; but is sometimes met with in children and in aged persons. It is often associated with phthisis, and may be found in the examination of many of the victims of that disorder, in whom there has been no suspicion of its existence during life. Ordinary inflammation—acute and chronic—has just been described as displaying itself, chiefly and primarily, in the intertubular areolar tissue and in the fibrous septa of the testicle and epididymis. Scrofula, on the contrary, is very much a disease of the tubular structure, the

areolar and fibrous tissues being involved, in most cases, only secondarily, in consequence of the inflammation which ensues, or by the development of tubercles in them; and often they escape till a late period. It attacks both the testicle and the epididymis, though not appearing in quite the same form in both, or at quite the same time.

Affecting the epididymis.—As a general rule, to which there are many exceptions, it appears earlier, and progresses more quickly, in the epididymis. The convoluted tubes of the epididymis become swollen and distended with white scrofulous matter, which is at first contained within the tubes, blended with the epithelium, and is made up, probably, in part at least, of accumulated and morbid scales of epithelium. In this condition the epididymis is enlarged in part, or

Fig. 506.

Scrofulous disease of the epididymis; *a*, body of the testicle unaltered.

usually in its whole length, to the thickness, perhaps, of one's finger; and, thus swollen, may be felt embracing the hinder, upper, and lower parts of the testicle. It is smooth on the surface: and the unaltered areolar tissue may be dissected from it, so as to disclose the tubular structure, which is still quite apparent, and which may be, to a greater or less extent, unravelled. The disease extends, commonly, for some distance up the vas deferens; and that tube becomes enlarged to two or three times its natural size, and is filled with yellowish-white scrofulous matter. [Fig. 507 represents a section of a tuberculous testis in the collection of Sir Astley Cooper.] Soon the mucous and other tissues of the tubes of the epididymis become infiltrated with, or degenerated into, the scrofulous substance, and gradually disappear, so that the coils of the tubes are blended and lost; and the epididymis is thus, more and more, converted into a mere bag of scrofulous matter. At the same time that matter softens; and, when the softening takes place, the surrounding areolar tissue inflames, and is infiltrated with serum and lymph, preventing the free movement of

[Fig. 507.

Tuberculosis of the testicle.]

the skin upon the part. As the softening progresses to suppuration, the epididymis becomes distended and fluctuating, presenting the condition of a scrofulous abscess; the skin becomes more adherent and inflamed, the intervening tissues are removed by absorption, and, the abscess bursting or being opened, the ordinary turbid scrofulous pus is discharged. The opening does not soon close, but continues for a long time—for months or years—to give vent to a thin watery fluid, and now and then to portions of earthy matter; and a narrow channel, with thick walls, feeling like a cord, may be traced from the skin to the diseased part of the epididymis. Commonly other abscesses form in a similar manner, and either burst through the same opening or give rise to other sinuses.

Affecting the body of the testis.—While these changes are going on in the epididymis, the disease makes its way into the rete and body of the testicle; unless, indeed, it has previously commenced in those parts. The rete becomes enlarged and consolidated; and its structure appears to undergo the same changes as that of the epididymis. In the body of the testicle the disease shows itself, at first, in a less uniform manner than in the epididymis. It appears in the form of small gray tubercles—very like the gray tubercles of the lungs—sparingly scattered through the tubular structure.[1]

[1] "The small isolated yellowish-gray bodies found in the testicle in the early stage

They do not, however, appear to resemble the pulmonary tubercles in softening down into separate vomicæ; but they enlarge and become confluent, and so occupy and consolidate considerable portions—it may be the whole—of the glandular structure, the intervening tissue remaining unaffected. Thus we occasionally find the lobes of the testicle more or less swollen from infiltration of yellowish-white scrofulous matter, yet distinct from each other, and separated by the areolar tissue and the fibrous septa, which still retain their natural characters. In other cases the areolar tissue becomes thickened, coarse, and indurated, as in ordinary chronic inflammation; or it may be absorbed, the lobes, as well as the tubes, being thus rendered confluent into one opaque, yellowish-white, cheesy substance, which fills up the whole space enclosed by the tunica albuginea. Soon softening commences, usually at the middle of a lobe; and an abscess is formed, which makes its way through the tunica albuginea and the superficial structures, just in the same manner as does the ordinary chronic abscess. As in that case, a protrusion of the altered substance of the testicle—"a hernia testis"—may follow, forming a coarsely granulated mass, covered, perhaps, wholly or in part, by soft white detritus of tissue, and presenting through the ulcerated opening in the skin. The changes that have been described may go on, *pari passu*, in the testis and in the epididymis; so that the glandular substance may be disorganized, and may present at the fore part of the scrotum, while the epididymis is converted into abscesses bursting through the hinder part and sides. I have also seen the swollen but unbroken body of the testicle, simulating "hernia testis," protruded through the skin which was ulcerated and undermined in consequence of the formation, spreading, and bursting of abscesses from the epididymis. More commonly, however, the disease in one part of the organ progresses more rapidly than in the other; and we find, accordingly, that when the epididymis has suppurated, there are often only a few tubercles in the testis, and when the latter is infiltrated or softened, the epididymis may be merely altered in shape, spread out upon, and, so far as external appearance goes, blended with the testis.

Tubercles.—Associated with this scrofulous affection of the lining membrane and epithelium of these tubules, there may be found genuine tubercles—the "miliary tubercles" of Laennec, the "granular or knotty tubercles" of Virchow—occupying the delicate connective tissue between the tubules. They sometimes exist alone, or precede the disease of the tubules. They enlarge by formation or proliferation of cells on their exterior, and become aggregated into larger masses, between which the tubules are compressed and destroyed; so that, in time, the affected lobules are converted entirely into tuberculous matter. Or, more commonly, the tubules are diseased

Fig. 508.

Scrofulous testis: *a*, thickened vas deferens; *b*, *b*, suppurated, ragged, partially destroyed epididymis; *c*, *c*, *c*, greatly enlarged and diseased lobes of the testis exposed by reflection of the tunica albuginea. They have been easily separated, the intervening tissue being soft and healthy.

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of the disease are composed of coils of diseased seminal tubes with altered contents." "The contents consist mainly of large cells, some of which exhibit vesicular nuclei, and are disintegrating; of smaller shrivelled cells or irregularly-shaped nuclear particles, and of a small quantity of granulo-molecular matter. The distension of the tubules in some places is sudden and globular, so that the distended portion, with its contents, forms a small tumor." "The matter accumulates until the tubes burst, and their contents are extravasated among the surrounding tissues." "With further disintegration more molecular matter and fat are developed, and at last earthy salts."—Dr. Andrew Clark, in Curling On the Testicle, p. 282, and Trans. of Path. Soc., vol. vi., p. 91. In vol. ix., Dr. Clark adds, that the "deposit has a different structure at different periods of its growth and at different parts of the same deposit. Thus, in the centre of a large deposit the structure is chiefly granular, at the circumference chiefly cellular." In one specimen he found numerous fine crystals of the triple phosphate between those tubes in which the deposit was being produced. The relation of these crystals to the pathological process he has not determined. See drawing by Cruveilhier, Anatomie pathologique, livraison 9e, Pl. I., fig. 2.

at the same time, so that their walls are destroyed, and the scrofulous matter in their interior is rendered confluent with the tuberculous matter on their exterior, forming a homogeneous mass, which undergoes the changes just described. These tubercles are found, most frequently, in the hinder part of the lobes of the testis, near to the mediastinum, and are regarded as indications of a more depraved constitutional diathesis than the scrofulous affections of the tubules. It is, however, impossible to distinguish during life between the two; and, even when the part has been removed from the body, it is not easy to decide whether the small spherical white bodies, commonly recognized as tubercles, are the genuine tubercles of the areolar tissue, or are the result of a degeneration of the tubular structure. Neither is the distinction of much practical or pathological importance. Probably it is the same disease in both instances, the difference consisting simply in the tissue in which it is seated.[1]

Scrofulous disease often affects both testes, though it is commonly more advanced in one than in the other. It is liable to extend along the whole length of the vas deferens, and to involve the vesiculæ seminales and the prostate gland, leading to changes in them corresponding with those in the testicle. I have also seen cases in which the disease was not confined to the genital tubes, but affected those of the urinary system also, causing dilatation of the ureters, pelvis, and calyces of the kidneys, with thickening and degeneration of the lining membrane and epithelium, so that the swollen tubes were almost choked up with scrofulous matter, while the cortical substance of the kidneys was streaked and spotted with yellowish-white deposit, or riddled with abscesses.

Reparative processes.—To what extent reparation may take place it is difficult to say. The examination of morbid specimens helps us very little. Clinical observation gives great reason to believe that, under favorable circumstances, scrofulous and tuberculous matter may undergo complete absorption, leaving the tissue which had been occupied by it quite unimpaired; and the inference derived from pathological investigation of similar products in other parts of the body is that they may fall into a quiescent state, the more watery elements becoming absorbed, while the remaining constituents are impregnated with oily matter or saline particles, so that the mass is converted into a substance like putty or soft cheese, or, finally, into a dry earthy lump composed chiefly of carbonate of lime. While these changes are going on, the mass is enclosed and isolated from adjacent parts by a capsule of lymph effused around it. We often see small circumscribed earthy masses in the body of the testicle, perhaps in the corresponding parts of the two testicles, or in the epididymis; and analogy leads to the supposition that some of these are the remnants of tuberculous disease, which has subsided and done little injury to the organ; and we occasionally find circumscribed tuberculous lumps which would be likely to be converted into these earthy masses. The knowledge of such conditions assists us in our practice; for it is not difficult to recognize these masses in the living subject, and we can relieve the patient's fears by the assurance that they are of little importance. Granted that they are of the nature supposed, they must be the result of very limited manifestations of the disease. It might be said that they do not warrant much hopefulness of the favorable termination of a more general invasion of the organ by scrofula. Nevertheless, my own experience of the disease, clinically, makes me very unwilling to condemn a testicle, even though it be the seat of severe and extensive scrofula. It is impossible to know that all the tubules are involved; and I have often been astonished at the good results that have followed, in apparently hopeless cases, from judicious treatment when the circumstances were favorable to the improvement of the health and the subsidence of scrofula. Particularly should this be borne in mind when, as so often happens, both testicles are diseased. ["Excision of the diseased testicle should be practised only as a last resort, and when the surgeon has indubitable evidence of the utter and hopeless disorganization of the organ. In more than one instance I have seen recovery take place after the gland had been doomed to the knife." (Agnew.)]

Diagnosis.—The recognition of the disease is not difficult. The appearance of the patient, the enlargement of the epididymis with thickening of the vas deferens, and, perhaps, enlargement of the testis, followed by slowly forming abscesses without much pain, the pain being chiefly confined to the period when the skin is inflamed, leave usually little doubt as to the nature of the case. Nevertheless, there are cases which deceive even the most experienced; and now and then a scrofulous testicle is removed under the supposition that it is malignant.[1] The

[1] See "Ein Beitrag zur Kenntniss der anatomischen und klinischen Bedeutung der sogenannten Hodentuberkel," von Dr. Hermann Demme, in Virchow's Archiv, vol. xxii., p. 155. Hulke, Med. Times and Gazette, vol. xxx., p. 280.

[1] Med. Times and Gaz., vol. xv., p. 452.

condition of the lungs should be investigated, especially when the patient has the tuberculous aspect. It is also well to inquire into the condition of the urinary organs; and if there are any symptoms of disorder in them, to examine the state of the prostate and the vesiculæ seminales, remembering that those parts not unfrequently suffer in the same manner as the testicle. Sometimes the disease is more advanced in them than in the testicle, but not commonly.[1] Hydrocele is not an ordinary accompaniment; but when it is present, the true nature and extent of the disease will probably not be ascertained till the fluid has been evacuated. It is not usually a painful disease. It may be grafted upon an attack of acute inflammation in those who are of scrofulous temperament; and this should be borne in mind in the treatment of epididymitis in such persons, and should induce us to adopt an invigorating regimen as soon as the subsidence of the acute symptoms will permit it. It may be induced by a blow. Often the disease has made considerable advance before it attracts the patient's attention; and he discovers by accident a lump at the hinder part of the testicle, or in its substance. Sometimes the part is painful and tender at the onset, and it is commonly so when softening and suppuration are going on.

Treatment.—The treatment consists, principally, in means calculated to improve the general health and impart vigor to the nutritive processes; and of these, fresh air out-of-doors, and well-ventilated, well-lighted apartments stand first in importance. Unless the pain and inflammation be such as to necessitate repose, the patient should be encouraged to go out, and to select—if it be in his power—a cool, bracing, rather elevated residence. He has less to fear from exposure to wet and vicissitudes of weather than from confinement and inaction. The poor man had better, if he can, remain at his daily out-of-door work than rest in the ward of a hospital. In the case of the town artisan the importance of this treatment is paramount. It is often the only thing wanted; but, unfortunately, it is often the thing which cannot be obtained, and we have to struggle on feebly with other means. Next in importance is a rather liberal supply of nutritious food—meat and beer—sufficient to satisfy the appetite, not to quench it. At the present day the last caution is much needed; for numbers of invalids are so plied with food that a natural appetite, and the vigorous digestion attendant upon it, are not suffered to exist. Sponging of the part, and of the body generally, with cold water is a useful adjunct. Steel, quinine, acids, cod-liver oil, are often of service. Iodine is thought much of by some persons; but its good effect in this and other scrofulous affections has not been so apparent to myself as it seems to have been to some practical men who have paid much attention to this class of diseases, and whose opinion deserves great weight.

The local treatment, though secondary to the general, is not unimportant; and where there is not the opportunity to carry out the measures on which we most rely, we must be the more persevering with those which are less effective. The part should be suspended, if it be painful, and soothing applications made. If it be not painful, it should be well sponged or sluiced with cold water several times a day. This is the best appliance, and, fortunately, it is an easy one; but there is often an inattention to it on the part both of the surgeon and the patient. An external stimulant sometimes does good; and iodine, in a fluid form, is more manageable and answers the purpose better than any other application. It should be used so as to produce a slight scaling of the skin. Abscesses may be allowed to burst, especially when they proceed from the epididymis. I do not think much good is done by opening them. In some very bad cases, where the organ seemed nearly destroyed, I have seen very good results from freely laying open the sinuses and cavities, turning out the scrofulous matter and softened structure, cleaning the part by washing and wiping, then freely applying nitrate of silver, and plugging the wound with lint, so as to induce active suppuration. At any rate, it is worth while to try this before determining to remove the organ. The healing of the sinuses which result from the bursting of abscesses cannot be much expedited in any other way. If the disease is not extensive or progressing, they may be left, and in the course of time they will close.

Excision.—We should be unwilling to proceed to extirpation of the organ, unless its presence is a great source of irritation and a drain upon the patient's health, preventing his getting about, and so tending to induce disease in the other testicle, or to aggravate the disease which may already exist there. It is surprising how this organ and other parts do, under favorable conditions, contrive to recover from scrofulous disease, and to resume their functions, though their structure was, to all appearance, completely disorganized. Moreover, it seldom happens that the whole of the glandular tissue is involved; and a small part of this may be sufficient to carry on the requisite func-

[1] Report of discussion at la Société Anatomique, Medico-Chir. Review, vol. xxviii., p. 272.

tion.[1] When the epididymis and vas deferens have been blocked up by scrofulous matter, or damaged by abscesses, the prospect of recovery to useful purpose is more hopeless. Still it is difficult to decide, for certain, by external examination, to what extent structural disorganization has taken place; and it is almost impossible to be sure that the tubes are so far destroyed as not to admit of being cleared out by absorption or discharge of their contents, and of being again enabled to afford a passage for the semen.

In considering the question of removal of the organ, the condition of the patient's health is a very important item. If he becomes more and more reduced, in consequence of the irritation and suppuration in the part, and of the confinement imposed by it; and if the local and general measures that are available, and usually serviceable, fail to produce a good effect, there is no alternative but the removal of the diseased part; and we should not be deterred from resorting to this step because of the presence of scrofulous disease in other parts of the body, or by the apprehension that, if it is removed in one place, it may make its appearance at another. I know that this idea is very generally entertained; and I think it is allowed to influence surgeons in their practice more than it ought to do. I do not deny that there may be some foundation for the idea; though I have never felt sure that it is laid very deeply in that which is the only reliable ground, namely, careful and extended clinical observation; and I think the converse statement is at least equally, if not more generally, true, viz., that the *existence* of scrofulous disease in one organ *predisposes* very greatly to its manifestation in others. We can understand that it should do so, not simply in accordance with the rule that disease tends to beget disease, and that disease of its own kind, but because it lowers the general health, and so renders the whole body a more easy prey to that or any other malady; and we find that it does this when we observe the numerous cases in which patients, worn down by scrofulous abscesses of the vertebræ, the joints, or the testicle, fall victims to tubercles in the lungs or the abdomen. It is remarkable that, in the face of these cases of every-day occurrence, the surgeon should still be deterred from relieving the system of a scrofulous organ by the apprehension I have mentioned. Upon the same principle, he should fear to restore a scrofulous organ by any of the ordinary means of treatment. If such a part be clearly a source of irritation and depression to the constitution, there can be little question that its removal will tend to prevent the accession of scrofula elsewhere. I think we may go a step further, and assert that the removal will not only tend to prevent the accession of scrofula but also to promote the restoration of organs which may be already affected by it. I have in several instances seen the health of phthisical patients much improved, and the condition of the lungs ameliorated, after amputation of scrofulous joints, or the excision of scrofulous testicles.

[1] When the testis is, to a great extent, disorganized by the effusion of tubercular matter or lymph, and forms an open fungoid sore, secretion may still go on under excitement, as is evidenced by the stiffened state of the dressings and a microscopic examination of the discharge. Curling, On the Testis.

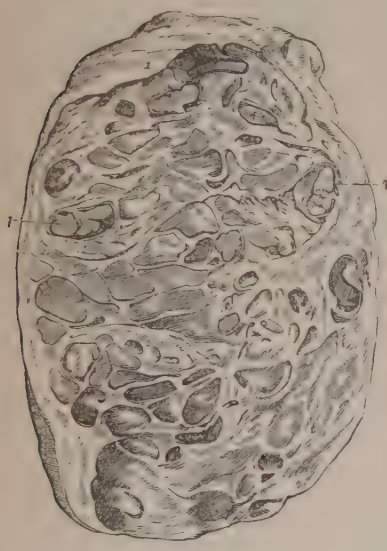
Cystic Disease,

Constituting the "hydatid testis" of Sir A. Cooper, is not of very frequent occurrence. It resembles that in the mammary gland, the ovary, and the kidney, inasmuch as it consists of an agglomeration of thin-walled cysts varying in size from that of a pin's head to that of a walnut, and of globular shape, modified by their mutual pressure. They are filled with fluid, which is mostly thin and colorless, containing granules, and delicate corpuscles; but which is sometimes viscid and tinged with blood or other coloring matter. They appear to originate in the substance of the gland, but whether in the tubular structure or in the areolar tissue connecting the tubules is not certain.[1]

[1] Mr. Curling, op. cit., p. 322, from the microscopical examination of two cystic tumors, confirms Sir A. Cooper's idea that the origin of the cysts is in a dilatation of tubes. "In some specimens a tube could be traced to a termination in a dilated pouch. In others a cyst appeared to arise from a lateral dilatation of a columnar tube, or at the extremity of a loop: whilst in the others the dilatation appeared to be uniform." These dilated tubes and cysts were lined by a tessellated epithelium, and contained no spermatozoa. He concludes that the tubes are not derived from the tubuli seminiferi of the glandular part, or from the ducts of the epididymis, but from the *rete testis*. If the cysts be really formed by dilatation of the seminal tubes, it is remarkable that spermatozoa are never found in them. Billroth (Virchow's Archiv, vol. viii., pp. 268, 453) traces the cysts to outgrowth from the seminal canals, herein according with the views of Reinhardt, Meckel, Förster, and others, with regard to the formation of cysts in the mammary gland. In one case he found well-marked, striped muscular fibres in the structure between the

They form masses attaining considerable size, and weighing, it may be, some pounds. As in the corresponding disease of the mamma and the ovary, the cysts are sometimes more or less occupied or distended by firm, fibrous, lobulated and pedunculated bodies growing into them. These bodies, examined by Mr. Quekett, were found to possess a cellular structure, and to be covered on the surface with cylindrical epithelium, like that covering the villi of the intestine;[1] or they may contain small, hard, spherical bodies like pearls, composed of concentric layers of condensed epithelium.[2] A variable amount of fibrous tissue is formed with, and intervenes between, the cysts. In some instances it is of small quantity and delicate; and the mass is then composed almost entirely of cysts. In other instances it is much thicker. It may be so thick as to constitute the chief element of the tumor; and the cysts then look as if

[Fig. 509.

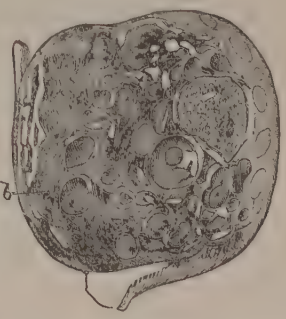


Section of a cystic tumor with lobular growths at 1, 1, 1, growing from the parietes of the cysts and obliterating these (Curling).]

they were mere secondary formations. To such the term "fibro-cystic tumor" has been given.

In most of the cases of the cystic growth which have been carefully dissected, it has been proved that the disease was not diffused through the organ, but originated and was circumscribed in one part, and that as the tumor grew, the unaffected portion of the testicle was pressed aside or spread out over the mass; so

Fig. 510.



Cystic disease: *a*, blood-clot in one of the cysts; *b*, glandular tissue of the testis.

that in some the mass, which is usually spherical, could be dissected or shelled out, leaving a considerable part of the testicle uninjured. The glandular tissue does not, however, under these circumstances usually contain spermatic filaments or seminal granules.[1] In other cases, however, although the glandular substance of the testicle could be discerned spread out upon the tumor, and microscopical examination proved its natural structure to be preserved, yet it could not be cleanly dissected away from the tumor. In some cases, also, a certain amount of gland-tissue has been found dispersed through the cystic mass. The epididymis, at first unaffected, becomes flattened, compressed, and wasted.[2]

Diagnosis.— The disease is most frequent between twenty and fifty,[3] and is

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cysts, and believes it to have been produced by a growth and metamorphosis of the connective tissue.

Mr. Paget thinks "it is essentially a fibrous or fibrous and cartilaginous tumor in the testicle, with more or less of cyst formation in the tumor."—Lectures on Surg. Path., by Turner, p. 478.

[1] Curling, p. 320.

[2] Virchow, Archiv, vol. viii., p. 399.

[1] Med. Times and Gaz., Sept. 4, 1869, p. 275.

[2] In a specimen examined by Mr. Ludlow (Trans. Path. Soc., vol. v., p. 216), the vas deferens, immediately continuous with the epididymis, was impervious and had been converted into a fibrous cord; the cysts were lined by a single stratum of spheroidal epithelial cells, and contained intra-cystic growths of firm fibrous tissue, cells of various forms and stages of degeneration, and some crystals of cholesterine.

[3] A rare instance of its occurrence in very early life, if not congenitally, is given in the Trans. of Path. Soc., vol. vii., p. 241. In this instance the cysts were lined with ciliated epithelium, and, in the opinion of the writer of the report (Dr. Carter), could not possibly be connected with the seminal tubes.

not unfrequently the result of injury. Its presence may be suspected when one testicle gradually and steadily enlarges, acquiring an oval or nearly spherical form, and is of moderate weight, heavier than a hydrocele, less heavy than a solid tumor. It feels elastic, but less decidedly fluctuating than a hydrocele. The affection is usually painless, and is unattended with any constitutional symptoms or indications of a predisposition to disease. The absence of transparency forms the chief distinction from hydrocele; and the slow rate of its growth may aid us in discriminating it from encephaloma. The diagnosis, however, from the latter disease, from hematocele, and from non-transparent hydrocele, cannot, in some instances, be arrived at with certainty except by the aid of punctures with a good-sized trocar. The instrument may be introduced at several points, and will probably give vent to a small quantity of clear fluid from each, indicating that several cysts have been punctured in succession. A grooved needle or a small trocar does not afford sufficient information, as either is liable to be blocked up by the clots or small flakes of lymph which may be present in hematocele or hydrocele.

Treatment.—Castration is the only remedy; and it may be resorted to as soon as there is evidence of the presence of the disease. It might be thought, forasmuch as the glandular tissue is usually found, in part, healthy and spread out over the tumor, that the latter might be enucleated, and the gland or sufficient of it left to perform its function. It is possible that this might be so in some cases, though it is scarcely compatible with the view that the disease has its origin in the *rete testis*. Supposing there to be only one testicle, and that one the seat of cystic disease, it would be well to cut cautiously down to the tumor, and endeavor to dissect or tear it away from the containing capsule, in the hope of leaving some of the tubuli and the efferent ducts uninjured. In ordinary cases, however, where the other testicle remains sound, the prospect of success from this procedure is scarcely worth the risk of the additional inflammation and suppuration which it entails.

The disease is in itself of a benign nature; is usually confined to one testicle; and when it is so, the patient may live for years after its removal, and have children. [In twenty-one cases reported by Agnew there were no deaths as the result of the operation. In the only one, however, who remained under his observation the disease returned in a few months, and terminated fatally.]

Association of malignant disease.—It has been observed, however, that in several instances the result has been less fortunate; the patient, after the lapse of a few months, being carried off by encephaloid disease of the lungs, absorbent glands, or other parts. This has naturally thrown a suspicion over the cystic affection, and has led many surgeons to regard it as of malignant nature. The truth appears to be that, though really of simple character itself, the cystic tumor is very liable to be associated with malignant disease, and therefore it practically deserves the suspicion with which it has come to be regarded. In these cases, if a microscopical examination of the tumor be made, the character of the disease may be commonly discovered by the presence of cancer-cells in the cavities of the component cysts or in some of them. It is not certain, under such circumstances, whether the disease is originally of cancerous nature, or whether the cysts are, at first, simple, and the cancer-cells are subsequently engrafted on them. Perhaps the former is the more probable, because we find, as a general rule, that growths which are cancerous are so from the beginning, the change from a benign to a malignant character being the exception. There are, however, some features which suggest the other view in these cases. Thus the relative amount of the cancerous to the other elements seems to increase as the disease goes on; and we sometimes find parts of the growth consisting entirely of simple cysts, while in other parts cancer-cells abound, and at certain points the mass presents the ordinary characters of encephaloma.

We learn from this that the prognosis as to the result after an operation in cases of cystic disease cannot be given without reserve, since it is impossible to tell whether the cysts are of a simple character or not. The cases which have progressed most rapidly are to be regarded with greatest suspicion, forasmuch as cystic tumors combined with encephaloma grow more rapidly than when they are of simple nature. Even after the tumor has been removed, a mere examination with the eye is not a sufficient test. The fluid should be taken from various parts of it, and submitted to inspection under the microscope, before we can venture upon an opinion as to the prospect of an invasion of other organs by the disease.

Mr. Curling has noticed the occurrence, in some of the cysts, of a solid whitish matter, exhibiting the characters of cholesteatoma, both in cases where the disease was malignant, and where it was not malignant.

There were also osseous spicules in the fibrous tissue, having lacunæ of irregular form and disposition, but no cartilage cells.

Association with enchondroma.—Another very frequent attendant upon cystic tumors is the formation of cartilage growths; so frequent, indeed, as to have elicited from some pathologists the statement that cystic and enchondromatous growths nearly always exist together. The cartilage usually is in the form of nodules, which appear to occupy and grow from the interior of the cysts. The nodules are sometimes found to be strung together into lines; and this corresponds with the view entertained by Curling, Hogg,[1] and others, that the cysts are the dilated tubes of the testis or its rete, and that the cartilage is produced in them. In a case examined by Mr. Paget,[2] the cartilage was disposed in tortuous, cylindriform, and knotty pieces, which appeared as if imbedded in filamentous tissue, but were, apparently with good reason, judged to be in the lymphatics of the gland. Further examination of these cases, however, is necessary to decidé positively which of the structures is the seat of the cartilaginous growths; whether they originate in the cysts, or in the intervening tissue and sprout into the cysts; if they originate in the cysts, it is still uncertain whether the cysts are diseased and dilated seminal tubes, or diseased and dilated lymphatics, or whether they are formed in the connective tissue of the gland.

The cartilage has the external characters and appearance of true hyaline fœtal cartilage, and very nearly corresponds with it chemically and microscopically. The cells are rather smaller, and clustered rather more closely and irregularly, than is usual in fœtal cartilage; and there are usually somewhat greater differences in the consistence and color of the several parts of the same mass. In some places it may be quite firm, and in others very soft; and, though it is for the most part pellucid and colorless, or with a faint bluish-white hue, in some spots, usually at the centre of the nodules, it is more opaque and yellowish. This may be due to a simple change of color; or it may indicate that a process is going on allied to ossification, but resembling it less closely than the ossification which takes place in the enchondromatous tumors found in connection with bone. The structure becomes infiltrated in patches with earthy matter, which, if we may rely upon one analysis,[3] is composed of a large proportion of phosphate of lime; still there are no true bone-cells or canaliculi. The "calcifying" or "ossifying" process is observed to have taken place to the greatest extent in those tumors which are of longest standing and of slowest growth; and if the growth were to be arrested, it seems probable that the whole tumor might become impregnated with earthy matter, so as to form little more than a hard concrete mass. I have not, however, met with any specimens in which this has taken place.

I have said that the growth of cartilage is usually consequent on the cystic growth, engrafted upon and subordinate to it, the nodules of cartilage appearing to be developed in the cysts, and forming but a small part of the mass. In some cases, however, the formation of cartilage proceeds so rapidly, exceeding that of the cysts, that the latter become choked up, and the traces of them are nearly lost; perhaps in many parts they are quite lost.[1] Or the cartilage may be developed in the tissue without there being any intermediate cystic formation. It appears to have been so in Mr. Paget's case. In this very remarkable and exceptional, if not unique, case the disease extended up the lymphatics into the abdomen; a cartilaginous growth projected from one of them into the vena cava, and there were numerous masses of the same nature in the lungs.

The presence of enchondroma may be suspected by the weight and hardness of the mass. The complication makes no difference either in the treatment or the prognosis of cystic disease. [The prognosis is rather more unfavorable. Early excision should always be resorted to.] Encephaloma may be associated with it, usually occupying a part of the cystic mass which is free from cartilage, though we sometimes find the nodules of the latter enveloped in the soft tissue of the cancer.[2]

[1] Trans. of Path. Society, vol. iv., p. 180.

[2] Medico-Chir. Trans., vol. xxxviii., p. 248.

[3] Mr. Barry found 100 parts of a tumor described by Sir A. Cooper as "very hard, in some parts cartilaginous, in others ossific," to be made up of phosphate of lime 45 parts, carbonate of lime with a trace of magnesia, 17 parts; animal matter, 38 parts.—Trans. of Path. Society, vol. iv., p. 184.

[1] In the case described by Mr. Curling, p. 324, "the enchondroma was developed so abundantly as to encroach upon and obliterate the cysts, and to form the chief bulk of the tumor."

[2] Dr. Lotzbeck (Virchow's Archiv, vol. xiv., p. 394) concludes from the examination of two specimens in which cancer was combined with enchondroma, that the cancer is the after-product and results from a metamorphosis of the cartilage-cells.

The results of 16 cases of cystic sarcoma of the testis tabulated in Med. Times and Gaz., vol. xi., p. 395, is as follows: The average age, 40; extreme ages, 18 and 58. Average duration, 21 months; extremes, 3 months and 11 years. Supposed cause, blows in 5. All recovered from the operation. There were cysts in all, enchondroma in 3, cancer

Fibrous Tumor.—A drawing of what appears to be a well-marked fibrous tumor of the testicle is given by Cruveilhier,[1] who observes that it closely resembled a fibrous tumor of the uterus, or rather the tissue of an unimpregnated uterus. It resisted and creaked under the scalpel. It was composed of contorted and interlaced grayish white fibres forming lobules, with vessels penetrating their interspaces. It was very heavy in comparison with the size, which was twice the natural size of the testicle. At the upper part of the tumor was a gelatinous mass, which seemed to result from an alteration of the fibrous tissue. M. Cruveilhier has several times observed a similar alteration in the fibrous structure of the uterus. He could discover none of the natural tissue of the testicle, and believes that the fibrous tumor was formed at the expense of the cellular tissue which unites the seminal tubes, and that the proper tissue of the gland was atrophied from compression. In this case there was no microscopical examination, and no sequel is given. The latter especially is necessary to assure us of the real nature of the disease; for, in some instances, where the appearance and minute examination gave the impression of an innocent fibrous or fibro-cellular tumor of the testis, the favorable prognosis has been soon disproved by the appearance of malignant disease in other parts of the body.

Sir B. Brodie mentions the case of a man who had one testicle enlarged and hard. Though the symptoms were not those exactly of chronic inflammation, he treated it as such, and administered mercury without avail. The testicle was amputated; and the structure was found to be peculiar, like very condensed cellular membrane, of the consistence of ligament. Between six and twelve months afterwards an apparently similar disease began in the other testicle. Under the administration of iodine, internally and externally, the disease diminished.

These examples, and I know of no others more nearly approaching to fibrous tumor, are not sufficient to assure us that this disease really affects the testicle.

Mr. Paget[2] speaks of a "fibro-cellular tumor," removed by Mr. John Lawrence, with the testicle, within the tunica albuginea of which it appeared to be entirely enclosed. The patient was a healthy-looking man, 37 years old; and the tumor had in seven years grown to a measurement of nearly six inches by four. When first removed, it was to the eye exactly like a fatty tumor, but it contained no fat, and was a typical specimen of fibro-cellular tumor in a very œdematous anasarcous state.

[Sarcoma occasionally affects the testicle. It begins in early life, is unilateral, involves the body of the gland at first and the epididymis late in the disease, is of slow growth, does not affect the general health, is painless, and does not implicate the scrotal tissues. Early excision is advisable. It frequently is coexistent with encephaloid disease, and can only be distinguished in typical cases.]

Cancer of the Testicle.

Of the four varieties of cancer usually recognized by pathologists, the "encephaloid" is of very frequent occurrence in the testicle; a few examples of the "scirrhous" and "melanotic" form have been met with;[1] but I have not found one recorded instance of the "gelatiniform" cancer of this organ.

Encephaloid cancer presents much the same characters in the testicle as in other parts of the body. It commences most frequently in the glandular portion, by the formation of small masses among the tubuli seminiferi. They gradually increase and coalesce, to the destruction of the glandular substance. Sometimes it begins at one point in the centre of the testicle, or in the rete; and the tubuli of the lobules are, at first, spread out over it. It has its origin less frequently in the epididymis. Mr. Wardrop gives a case where the tumor grew from the surface of the tubuli testis, immediately under the tunica albuginea, and Sir B. Brodie one in which the glandular structure of the testicle remained in a natural state, while there was a large fungous tumor completely occupying the tunica vaginalis.[2] It is only when the tumor is examined in an early stage that we can tell where it began; for all the structures soon become involved and destroyed by the disease, and the whole is reduced to a cancerous mass, in which none of the natural components of the testicle can be traced. The mass has a soft pulpy consistence and, commonly, a more or less uniform white

in 1, cholesteatoma in 1. The gland-structure was expanded over the tumor in 8, lost in the tumor in 4, not described in 4. The epididymis was healthy in 6, involved in the disease in 3, not described in 6. Intracystic growths were developed in 3.

[1] Anatomie Pathologique, 5e livraison, pl. i., fig. 3.

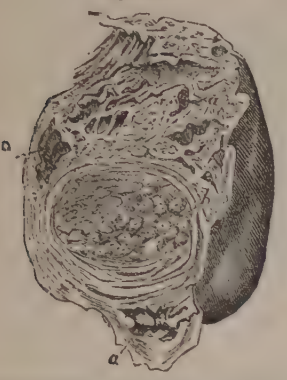
[2] Surgical Pathology, vol. ii., p. 118.

[1] Mr. Curling mentions two instances of scirrhus, and three of melanosis. The occurrence, however, of true scirrhus, like the scirrhus of the mammary gland, is extremely rare, indeed is almost disproved by the more searching observations of modern pathologists. In Path. Trans., xviii., 184, is the report of a case in which hard cancer and sarcoma existed side by side in the testicle.

[2] This case is related and represented by Sir A. Cooper. One apparently similar is given by Sir E. Home, Obs. on Cancer, p. 125.

or pinkish-white color. When squeezed, a creamy fluid oozes from its cut surface at a multitude of points; and if a stream of water be directed upon it, the greater part is washed away, leaving a flocculent, filamentous, areolar structure, in the

Fig. 511.



Encephaloid testicle, with a ball consisting of cartilage nodules, fibrous and cystic structure in its substance: *a a a*, ragged cavities containing fluid and clotted blood, and many-colored remnants of clots; *b*, hyaline cartilaginous nodules with central opaque spots.

interstices of which the creamy fluid has been contained. It is usually so soft, and the areolar basis is so fragile, that it is liable to give way in consequence of a slight blow, or without any such cause, and blood becomes effused in its substance. This may take place at many points, interstitially, or into ragged cavities formed by the pressure of the blood; and the effused blood, undergoing changes, gives rise to a variety of appearances and discolorations. Sometimes the fibrous skeleton is thicker and tougher, giving a firmer consistence to the mass and simulating "fibrous tumor," and it may be arranged in places concentrically, so that the more fluid elements appear as if they were arranged in cysts. Or there may be cystic disease combined with the cancer. It not unfrequently happens also that masses of cartilage are present; and this combination is more frequent in the testicle than in other parts of the body. In a case, a section of which is represented in the accompanying figure, where the testicle had attained to a very large size in a year from the time when enlargement was first observed, I found numerous small thin-walled cysts, containing clear serum, scattered throughout the encephaloid structure. They appeared to have been secondary to it, or to have grown together with it. In the middle of the tumor was a hard spherical mass, as large as an orange, composed of compact fibrous tissue with small cysts, some of which contained clear fluid, and others were filled with nodules of cartilage. From the short period during which the testicle had been enlarging in this case, it would seem that the several growths—cystic, fibrous, cartilaginous, and cancerous—had commenced and gone on together. The variety in them, perhaps, depended upon the different structures involved; the more solid elements originating in the mediastinum and rete, and the softer components in the glandular part of the testicle; just as we find cancer of the breast to be associated with a considerable development of fibrous structure, and cancer of the bones to be attended with a marked growth of fibrous and osseous tissue.[1]

Changes of a different kind, due to degeneration of parts of the growth, may also take place. Softening may occur, producing cavities filled with grumous, pultaceous substance; or the cells and tissue may become impregnated with oily matter, giving a yellow color to parts. None of these changes are of much practical importance, or affect materially the progress of the disease.

Gradually the mass increases; not, however, quite steadily. There are often periods during which it seems to be quiescent;[2] or an actual temporary diminution of size may be caused by absorption of fluid effused during the earlier stages into

[1] In most of the cases of combined enchondroma and encephaloma the two morbid products have not been blended, but, as in this case, the cartilage has formed a separate mass imbedded in the cancer. The consecutive disease in other parts of the body has usually consisted of cancer unmingled with cartilage.

In specimen 2429A in the College of Surgeons, portions of bone-like substance, resembling light osteoid tumor, are imbedded in the mass. I do not know any other example approaching to osteoid cancer in the testicle.

[2] In a case which lasted more than five years, the slow progress was attributed to the process of retrograde metamorphosis in the centre of the tumor nearly balancing that of growth at the circumference. Trans. of Path. Soc., vol. x., p. 205. In another case of similar duration the mass was firmer than usual. Med. Times and Gaz., vol. xx., p. 291. The following is given by Mr. Paget (Surg. Pathology, vol. ii., p. 394) as an example of arrest or suspension of the progress of cancer. "A man 38 years old had slight enlargement of one testicle for 15 years, and its rate of increase was often inappreciable. At the end of this time rapid growth ensued. On removal, well-marked medullary cancer was found, and was the only apparent source of the enlargement. He died soon after the operation with recurrence of the disease."

In a case related in the Lancet, Aug. 10, 1861, the tumor is said to have grown to the size of a new-born infant's head in sixteen weeks.

the tunica vaginalis. The hope thus engendered is only destined to be soon dispelled by the rapid progress of the malady. The tunics of the testis yield under the pressure of the quickly-increasing tumor more readily than might have been expected, and become stretched to a very great extent; so that although the tumor may attain to large size, they seldom give way. Sir A. Cooper speaks of the disease making its way through them and projecting as a bleeding fungus through the ulcerated skin, and I have a patient now under my care in whom this is the case; but as a general rule, before there is time for this to have taken place, the testicle has been amputated, or the disease has extended along the spermatic cord to the abdomen, the lumbar glands and other organs have become involved, and the patient has sunk under the depressing and destructive effects of the disease.

Cancer of the testicle makes its appearance at all periods of life, from the earliest infancy[1] to old age, but is most frequent from twenty to forty. It is rare after sixty. It has been observed in the undescended testicle in several instances (see p. 895).

Symptoms.—Quickly progressing solid enlargement of the testicle, without inflammation, is the great, the almost infallible indication of the disease. Whenever we can make sure, therefore, that this is going on, we may be pretty certain that there is medullary cancer. The enlargement is general, the testis and epididymis being usually blended at an early period. The part is at first rather firm; and the firmness is uniform, and the surface smooth. After a time the mass becomes softer, at some parts more than others, so as to have a pulpy, elastic, or fluctuating feel, tempting a lancet-thrust. It is not commonly very tender or painful. If there is pain, it is dull, not acute or lancinating. Pressure does not elicit, at any part, the peculiar sensation of the testicle being touched. The veins of the scrotum become turgid. The cord is free at first; and the vas deferens can be felt to be natural. Soon the cord becomes thick and full from turgescence of its vessels, perhaps thick and firm from deposit of medullary matter in it. As the disease progresses, the health suffers, the patient becoming weak and thin, with anxious expression. It is, however, important to remark that this alteration in the general health is by no means constant, or even usual, in the early stages, and that it has, therefore, no necessary connection with the malady, but is only a result of the effects of the malady upon the constitution. So much is said and written about cancerous cachexia, that cachexia comes to be regarded as a necessary associate of cancer. Hence physicians and surgeons rely upon it as a means of diagnosis, and conceive that a disease cannot be cancerous because the patient's health is good; whereas, in reality, cancer, especially in early and middle life—the periods in which the testicle is most commonly attacked—fastens itself often, I would say oftenest, upon those who are well nourished and florid, who seem the most healthy and robust, and so give promise of long life and vigor.

Although the diagnosis of medullary cancer may seem to be easy, the mistakes which frequently occur prove that it is not always so; and there are few surgeons who have not been puzzled, and occasionally foiled, in distinguishing it from non-transparent hydrocele, hematocele, and cystic disease, and, in its early stages, from syphilitic disease. If a testicle, which has enlarged quickly, is solid, it is, in all probability, medullary; but the difficulty, in some cases, is to be certain that it is solid. The weight, the sense of fluctuation, and the history, will enable us to decide this point in many cases; but we often require the additional information afforded by a trocar or an incision. It is best to resort to the latter, as it affords the most certain information, and is the best treatment in those cases of hydrocele and hematocele that are likely to be mistaken for encephaloma.[1] The diagnosis from cystic disease may be based partly upon the rate of growth, but especially upon the information elicited by the trocar. It is not of so much importance, because the treatment is the same, whether the growth be cystic or medullary, and, as has been already said, the two diseases are often combined. The point of most practical importance, and of greatest difficulty, is to distinguish cancer of the testicle, in an early stage,

[1] In the College of Surgeons (No. 2401) is the section of a large medullary tumor from the testicle of an infant seven months old. It has been known to exist in several instances in children under two years. See microscopical examination of malignant tumors of the testicle, from boys aged five and three, in Trans. of Path. Soc., vol. xi., pp. 161, 165. The tumor from the younger boy was judged from the examination to be innocent, "fibro-nucleated;" the sequel given in vol. xii., p. 164, proved it to be malignant.

[1] The amount of blood which flows through the canula of a trocar thrust into an encephaloid testicle is sometimes so great as to lead to the supposition that it must be a hematocele. It is to be remarked, however, that in such cases the diminution of the swelling is not so proportionate to the flow of blood as it is in hematocele.

from enlargement caused by inflammation—simple, syphilitic, and scrofulous.

[The difficulties of deciding upon the true character of any chronic growth or enlargement of the testicle are so great that it seems worth while to give a résumé of the chief characteristics of the three diseases most likely to be confounded with one another.

Syphilitic orchitis.—History of syphilis: most common in middle and later life; other symptoms of syphilis often present; duration several years; is comparatively small; is more frequently seen than the others; may be smooth and oval, but is often lumpy; body of gland primarily affected; heavy; painless; skin rarely involved; ulceration or suppuration rare; no change in scrotal veins; both testes often attacked; fungus very rare, if present is hard, yellow, does not bleed easily, no sinuses, slow and painless in growth; no glandular enlargement; very curable under proper treatment.

Scrofulous or tubercular orchitis.—History of tubercle or scrofula: most common in early youth and manhood; duration longer than syphilitic sarcocele; medium size; next in frequency to above; knotty, irregular; epididymis first affected; no pain, absence of normal sensation; skin involved just before formation of abscess; suppuration common; no change in scrotal veins; both testes often affected; fungus not common, if present, pale, bleeds easily, has sinuses, is slow of growth and painless; no glandular enlargement; generally incurable.

Encephaloid orchitis.—No history of syphilis or scrofula, possibly not of cancer; most common in youth; duration short, average, two years; attains great size, often immense; least common of the three; uneven, hard and soft spots, indefinite fluctuation; body of testis first affected; severe lancinating pain, worse in later stages; skin of scrotum involved; ulceration common; scrotal veins enlarged and varicose; usually only one testicle suffers, fungus always present, bleeds readily, soft, ichorous, sloughing, offensive, painful; inguinal and pelvic glands involved: fatal, kills by hemorrhage or cachexia if not removed, by return of disease if extirpated.

These differential symptoms have been condensed from the excellent diagnostic tables contained in the works of Agnew and Van Buren and Keyes.]

The absence of the symptoms of inflammation is so frequent in inflammatory affections that this negative symptom helps us very little; and our opinion is rather to be formed by observing the influence upon the swelling of those remedies which are usually of service when it is of inflammatory nature. If we find that the swelling does not yield to antiphlogistic measures, with mercury and iodine, but goes on increasing, we have reason to fear that it may be caused by some growth, malignant or other, in the testicle. The difficulties of diagnosis have been found to be very great when a retained testicle has been the seat of malignant disease.[1]

The disease usually terminates fatally in about eighteen months or two years;[2] and it does so less by the changes it induces in the testicle than by its effects upon distant organs and upon the constitution. Sometimes the inguinal glands are involved. More commonly it spreads up the cord into the abdomen, attacking the lumbar glands, and giving rise to the formation of masses which compress the vena cava and thoracic duct, destroy the bodies of the vertebræ, press upon the spinal cord or the nerves, or impair the action of the abdominal viscera. The most distant organs also become the seat of its ravages, particularly the lungs. Cancer of the lungs is not a very common affection; but I have observed it to occur more often as a sequence of that disease of the testicle than of other parts. It rarely affects both testicles.

Treatment.—The removal of the part should not be attempted unless there be a fair prospect of taking away the whole disease. If it has spread up to the inguinal canal, or if there is a tumor in the abdomen, it is not worth while to subject the patient to an operation.[3] After complete extirpation, the prospect is no better than after similar operations for cancer in other parts. Indeed the tendency to secondary disease seems to be remarkably strong when the testicle has been the primary seat of cancer; so that the en-

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[1] Med.-Chir. Trans., vol. xxx., p. 10.

[2] In Med. Times and Gaz., vol. xix., p. 258, two cases are mentioned in which the disease terminated fatally, without operation, four months from the time at which it was first observed in the testicle. Cases have been mentioned in foot-note, p. 933, in which life was prolonged to five, and even fifteen years.

[3] It would seem that quite sufficient attention is not paid to this point. Of 36 cases collected in the Medical Times and Gazette, vol. xix., p. 258, three died within a week, and cancer was found in the lumbar glands; two died within six weeks, and two within three months of the operation. There was, in each, disease of the lumbar glands, or lungs, or both. In a specimen in St. Thomas's Hospital Museum the cord is healthy for an inch and a half above the testis, and then is expanded by encephaloid disease, which was not discovered before the operation.

In Path. Trans., vol. xvii., p. 180, is recorded a case in which both testicles were removed for sarcocele supposed to be of malignant nature.

courage ment to surgical interference is not great; and the most that can be said is, that life may be prolonged thereby a little. One patient lived four years, under my observation, after the removal of a well-marked medullary testis, and died, as we believed, of phthisis; but a post-mortem examination was not obtained. Sir B. Brodie heard of one patient alive and well three or four years after the operation. Mr. Curling relates four cases in which the patients were well at the respective periods of ten, four, nine, and twelve years after the operation; and quotes four others from Dr. Baring, of Hanover, in which considerable periods had elapsed without return. Mr. Cock mentioned the case of a man whose testis he removed for medullary cancer, who was in good health six years afterwards, and emigrated to Australia.[1]

It is to be observed that the presence of cartilage cells or masses of cartilage may be commonly detected in the secondary or the recurrent form of the disease, when cartilage exists in the primary formation. See cases of this kind reported in Med. Times and Gaz., May, 1869, p. 503.

Calcareous, Osseous, and other Formations.

Mention has already been made of the formation of calcareous flakes or masses in the testicle and its coverings. They are generally the result of the earthy impregnation of lymph or scrofulous deposits. It is not uncommon to find them in the tunica vaginalis as spots, streaks, or flakes, occupying, perhaps, a considerable part of the tunic. It may be in the form of fine sand on its surface; or there may be rough nodulated lumps in its cavity, consequent on changes taking place in lymph effused there. Sometimes they are in the substance of the testis or the epididymis; and the whole of the gland has been converted into an earthy mass. I am not aware that these deposits have been traced to a gouty cause, or that they have been found to consist of uric acid in combination with an alkali. Now and then the vas deferens has been discovered choked with earthy matter, or to have undergone calcareous degeneration in a greater or less part of its length.[2]

Bone, skin, hair, teeth.—Like the ovary, the testicle is occasionally the seat of dermoid cysts, having much the structure of true skin, with cuticle, hair-bulbs, and sebaceous follicles, and containing the products of these structures, viz., epithelial scales in various states, hair, and waxy or oily matter. Sometimes, in addition, masses of bone, with or without teeth, are embedded in the wall of the cyst; and there may be other solid matter, fibrous or cerebriform, with cavities containing fluid of various colors and consistence. The osseous masses, which may consist of true bone, are generally of irregular shape, and uneven on the surface; and the teeth, which may have crowns and fangs like ordinary teeth, are commonly crooked and disposed in a disorderly manner, quite unlike the teeth in a jaw. These tumors have, in most instances, been observed soon after birth, and are, probably, usually congenital. The rate of their increase varies a good deal. Sometimes they do little more than increase *pari passu* with the growth of the individual; or they may grow at a somewhat quicker rate; and they are liable to sudden accessions of increase, which may be due to an injury, and may be attended with inflammation. The inflammation has, in one or two instances, gone on to suppuration; and the bursting of the abscess has been attended, or followed, by the discharge of oily matter, hair, teeth, or bony fragments. In the greater number of recorded cases these masses appear to have been developed in the testicle; but it is not certain, from the description of other cases, that this was so; and in the one described by Velpeau, the tumor could be dissected from the testicle, which was slightly atrophied.

In accordance with the views of Geoffroy Saint-Hilaire, these tumors have been thought by most pathologists to be due to "fœtal inclusion;" that is to say, it is conceived that the more or less imperfect germs of a second fœtus have become included in the testicle during development. It may, however, well be doubted whether such a process ever takes place; and the probability of its being the cause of the formations in question is, to my mind, very small. They are far more likely to be the result of departures from the natural formative processes in the testicle at a period when the developmental forces are in activity and when morbid products are more prone to be composed of natural structures than they are when occurring at subsequent periods of life. Moreover, the peculiar function of this organ and of the ovary may predispose either gland, under certain circumstances, to the evolution of some structures which, in the natural course of things, should result from the combination of their secretions. The "*hétérotopie plastique*" of Lebert, in other words, the production of these structures by forces existing in the part, is, I

[1] Med. Times and Gaz., vol. xix., p. 287.

[2] Mr. Gamgee (Surgical Researches) has collected numerous examples of "calcification and ossification of the testicle and its appendages in men and animals."

think, more in accordance with other teratological and pathological phenomena than the "*inclusion*" theory of Saint-Hilaire.

The only treatment is extirpation, which should be performed if the tumor increases or is a source of inconvenience. The tumor is not likely to be of malignant nature, nor to be followed by any disease of that kind in other parts. In none of the cases which have been recorded, however, has the sequel been sufficiently given to determine this point. It is quite possible that encephaloid disease may be engrafted upon it, and may have been, in some instances, the cause of the more rapid increase of size. In performing the operation, it should be remembered that the testicle may be free, and that in one case (Velpeau's) it was left uninjured, though the patient died of purulent infection.[1]

The *operation of castration* is very simple and easily performed. Yet, to perform it well and to ensure success, as far as possible, it is necessary to attend to some minor points. The incision, commencing at the external ring, should go quite to the bottom of the scrotum, so as to afford a drain for fluids that might otherwise accumulate in the wound.[2] It is seldom necessary to remove any skin; but if it be desirable, a good deal may be cut away without interfering with the healing of the wound. The superficial structures having been reflected from either side, an assistant should hold the cord between his finger and thumb, to prevent its escaping into the inguinal canal after its division. This is most likely to occur when the testicle, being large and heavy, has dragged the cord down. A good deal of trouble has, in some cases, ensued from neglect of this precaution, it having been found necessary to cut into the inguinal canal in search of the cord; and this has been followed by peritonitis. When the testicle is not large, or when the cord can be divided at some little distance from the inguinal canal, there is no fear of disappearing; and in such cases, I have operated quite alone, without any assistance, and have experienced no difficulty. In dissecting out the testicle, the raphé of the scrotum and the penis are to be avoided. Some pains should be bestowed on the process of securing the bloodvessels of the cord and of the scrotum; for unless this can be carefully done, there is liability to hemorrhage after the patient is in bed. I suspect that secondary hemorrhage after operations may, in this and almost all operations, be prevented by properly securing the vessels at the time. The vessels of the cord should be tied separately. There are usually two, the spermatic and deferential arteries; there may be more. It is a bad practice to include the whole cord in one ligature; first, because unnecessary pain from tying the nerves is likely to be so caused; secondly, because it is never safe to include much tissue in the knot with an artery. [If a pin be passed between the vas deferens and the other portions of the cord containing the bloodvessels, and a twisted suture or ligature thrown around its extremities, the operation can be more rapidly performed, the cord will be under complete control, and the ligature can be removed at any time by simply withdrawing the pin. The artery of the vas deferens is very small, often does not bleed at the time of operation, and may escape observation, in which case hemorrhage will occur after the wound is closed. By the use of the pin this is prevented. Many surgeons invariably follow this plan with no evil results.] When this is done, it is probable that the division of the inner coats of the artery by the thread, which conduces much to the closure and healing of the vessel, may not be effected; and then, after a few days, the included tissue, softening and becoming absorbed, may leave the ligature loose and the vessel free to bleed. I have several times attributed, and I believe correctly, secondary hemorrhage to this careless mode of tying vessels.[1] The interior

[1] Dr. Verneuil (Mémoire sur l'inclusion scrotale et testiculaire, republished from the Archives générales de Médecine, juin, 1855, et suivants) describes one case, and has collected nine others. He advocates the inclusion-theory very strongly, arguing much from the resemblance of some of the products to bones and other parts of the fœtus. In considering such a question, however, we must take the observations with some reserve, and must make some allowance for the imagination of anatomists and pathologists, which has always shown itself remarkably fertile in resemblance of that sort. Similar tumors have been found in the horse's testicle by the late Mr. Bowles, of Cambridge. Indeed, I believe structures of this sort—natural structures—are more liable to be developed abnormally in the lower animals than in man.

Tilanus (Schmidt's Jahrbücher, c. 171) describes a congenital cysto-fibroid of the testicle removed from a man aged twenty, containing hair, sebaceous glands, well-developed cartilage, and bone.

[2] To secure better drainage, Aumont proposed to make the incision along the hinder part of the scrotum instead of in front, and the plan has been adopted in England; but it must be attended with some inconvenience, and is not necessary.

[1] In a case where hemorrhage ensued profusely an hour after tying the cord *en masse*,

of the wound should be roughly sponged, over and over again, to remove clots and cause the vessels to bleed; and all that do bleed with any briskness should be tied. The surgeon should endeavor to tie them all at the time of the operation, and should close the wound while the patient is under the influence of the chloroform. It is often recommended to leave the wound open for a few hours, because of the probability of hemorrhage. This plan tends to make the surgeon less painstaking in tying the vessels; and when it has been followed, I have often found that bleeding has occurred, and it has been necessary either to administer chloroform again, or to put the patient to much pain in securing the vessels and closing the wound. The edges of the skin should be approximated with sutures; and no other dressing of any kind should be applied, no plaster, no compress, no bandage. For many years I have followed this plan in the treatment of wounds after operation, with very few exceptions, after amputation, hernia, breast-excision, etc., leaving the wound quite uncovered, and have made some efforts to impress upon others the advantage of it. I am glad to find the practice is being adopted in some hospitals, and feel sure that in time it will be universal. No dressings being applied, there are none to be removed and re-applied; the wound is kept cool, and can easily be kept clean and pure, and discharges find a ready escape. If anything goes wrong, it is at once detected, and the removal of a stitch or slight opening of the wound will give vent to matter and relieve the part; or a poultice may be applied. A poultice is better than lint under oiled silk, being softer, and adapting itself more completely to the inflamed surface. The general treatment must depend upon the habits and requirements of the patient in each particular case. I never operate upon a florid, robust person —especially after middle life—if I can help it, without some previous preparation by aperients and regulated diet; and believe that by this precaution erysipelas, so-called pyæmia, and other ill consequences may often be prevented.

(Though I leave the above paragraph as it stood in the former edition, I must add that since it was written I have seen cause to deviate from the practice there advocated in two particulars. 1st. I rarely now use the common ligatures, employing either the carbolized catgut, or more usually resorting to torsion, which, if carefully employed (it requires more care and patience than the ligature) is generally sufficient. 2dly. After the vessels have been secured, I sponge the surface of the wound well with carbolic acid. I do this, not as a thorough convert to the antiseptic views, but because I think that the wound heals better and more quickly when this is done.)

The surgeon should ascertain whether there be hernia on the side to be operated on, and if there is, the extent to which the sac descends upon the cord; and he must be careful not to interfere with it. It may be necessary to dissect the cord from behind the sac. I was fully impressed with the need of caution in this particular by finding, after the operation of castration had been performed on the dead subject in lecture, that the lower part of a hernial sac had been removed with the testicle. Sir E. Home relates a case in which the dressings were forced off by a protrusion of the intestines during a fit of coughing.[1]

A fatal result has not followed in many cases, and in some of these it might have been prevented. For instance, it has resulted from hemorrhage in consequence of retraction of the cord before the vessels were secured, and from peritonitis occasioned by searching after the retracted cord. More frequently the cause of death has been erysipelas,[2] or suppuration in other parts of the body (pyæmia).

Functional Disorders of the Testicle.

An interesting and important, though difficult and rarely discussed, point in

and other expedients failed, the bleeding was finally arrested by a large Signorini's tourniquet applied so as to compress the cord on the pubes. Med. Times and Gaz., vol. xiv., p. 339. The écraseur has been used to divide the cord, but is not to be preferred to the plan of cutting it through and tying the vessels separately. Moreover, experience tells us that, though bleeding may not occur at the time, it is liable to take place a few hours after the use of the écraseur.

[1] Mr. Curling "removing a large carcinomatous testicle, accidentally opened, in dividing the spermatic cord, a hernial sac containing a small piece of omentum, of the existence of which he was not aware. A compress was applied at the groin, and no ill effect followed."

[2] Two fatal cases of erysipelas are reported in the Med. Times and Gaz., vol. xix., p. 256. In both there was malignant disease of the lumbar glands. Of 36 cases of castration for malignant disease reported in that journal, 26 recovered; the number of deaths was greatly dependent upon the invasion of other organs by the disease, and the consequent cachectic state of the patients; the proportion of recoveries when the disease was not malignant was 26 to 1; a low form of phlegmonous erysipelas was the cause of death in the one fatal case.

physiology is the relation of the generative apparatus to the moral character, and the degree in which the former is subservient to and regulated by the latter. I think it would be found that it is so to a very great extent, to a greater extent, perhaps, than is usually recognized; and it is desirable that practical men should pause awhile upon a question of this sort, and not hastily commit themselves to opinions which may have much influence upon the well-being and happiness of society. There are no organs so much under control as those of generation. Their functions are neither directly nor indirectly, in the least, essential to life, scarcely even to the well-being of the body; indeed, which is more remarkable and unusual, they are scarcely essential to the maintenance of the structure of the organs themselves in perfect integrity. The functions of the testicle, like those of the mammary gland and the uterus, may be suspended for a long period, possibly for life; and yet its structure may be sound and capable of being roused into activity. In this respect its qualities peculiarly adapt it for subserviency to man's moral nature. Not that it yields a tame and easy submission. By no means. That stern struggle between the moral and the physical is one of man's greatest trials; a trial which it may be presumption voluntarily to encounter, yet a trial which is, at some time or other, laid upon most men; and it is some satisfaction to know, that if the victory be with the moral, it is not necessarily at the expense of the physical. It is, perhaps, partly with the view of giving strength for this control, or rather of disarming the antagonist, that the advocates of celibacy among the clergy are usually the advocates also of stringent and regularly repeated fastings.

The earliest and most frequent cause of disorder of the generative apparatus is the practice of self-abuse, the tendency to which is strongest about the age of puberty. At that time there is considerable excitement about these organs, increased, perhaps, by the conversation and thoughts which are indulged in; and it is apt to be unchecked by the moral control, which has not yet acquired its proper influence. Moreover, lads are often induced to the pernicious practice by their companions, who may be as ignorant as themselves of the wrong and mischief they are doing. It would be a very good thing if those who have the charge of boys were less scrupulous in giving warning upon this matter. Much trouble and anxiety might be spared by timely advice seriously and kindly given. From no one could this come better and with more authority than from the medical attendant, who often has, or may find, an opportunity of giving a hint in time; and, if I am not much mistaken, his kindness will generally be well appreciated. An extensive acquaintance, through years, with those who have just come from our schools, has impressed the importance of this matter upon me. Often, unfortunately, the habit is commenced at an earlier period than I have mentioned, as early, perhaps, as the age of ten or twelve. The pernicious effects are evinced *first* in inducing a weakness and irritability in the organs themselves, with nocturnal emissions, or emissions occurring during the day under slight excitement, imperfect or transient erections, premature ejaculatio seminis, etc.; *secondly*, in a general enfeeblement of the frame and disorder of the various functions, in indigestion in some of its many forms, palpitation of the heart, nervousness and impairment of the mental vigor, epileptic and amaurotic symptoms, or even paralysis; *thirdly*, in its influence on the character, in a lessening of the moral courage and the engendering a tendency to shyness, hypochondria, reserve, and solitariness. The mind becomes engrossed with the one subject; and this unfits it for high thought and bold resolve. The man is lowered in his own estimation by the consciousness of yielding, or having yielded, to a secret habit, and is haunted by the thought of the mischief he has entailed on himself. He seeks the advice of a medical man, yet shrinks from divulging the real cause of his maladies, while he excites suspicion of it by his fidgety absent manner and downward glances.

[It is certainly open to reasonable doubt whether extremely grave symptoms are ever produced by masturbation, except in persons already predisposed by heredity or otherwise to nervous affections.

I happen to have had exceptional opportunities for observing adult masturbators and their diseases during a term of service as surgeon to the Eastern State Penitentiary. The results of these observations I have stated at length elsewhere,[1] but it may be said here that they offered conclusive proof that organic disease of the nerve centres stands in a causative relation to masturbation and its accompanying evils. For instance: "Of all those in confinement, 58 per cent. were received in impaired physical or mental health, or were considered likely to develop disease from hereditary defect; while of the onanists, 85 per cent. were the subjects of mental or physical disease at the time of admission, or were hereditarily predisposed to such disease." Of a certain class of transgressions, known as "crimes of the pas-

[1 Report of Board of Inspectors of Eastern State Penitentiary, 1875.]

sions," depending largely on a want of mental balance, and including not only manslaughter and attempts at murder, but also all the sexual aberrations, rape, buggery, sodomy, etc., thirteen per cent. of the whole number of criminals had been convicted; among the onanists, *i. e.*, those prisoners who were known by actual observation to be guilty of frequent masturbation, fifty-six per cent., or more than four times the proportion, belonged to this class. So, too, the deaths from disease of the nerve centres were four times as frequent, and the re-convictions, showing a corresponding moral defect, were twice as many as among other prisoners. When these facts are carefully considered, and when, too, we remember the great prevalence, almost universality, of the habit among boys and very young men, and the comparatively few cases in which serious troubles are even suspected, we are constrained to deny much importance to masturbation as an etiological force in the production of disease. The oft-quoted dictum of Sir James Paget still expresses beyond a doubt the opinion of the large majority of observant physicians on this important question: "Masturbation does neither more nor less harm than sexual intercourse practised with the same frequency in the same conditions of general health, age, and circumstance." "The mischiefs are due to the quantity, not to the method, of the excesses; and the quantity is to be estimated in relation to age and the power of the nervous system." I speak of the question as important, because there are probably no greater sufferers than the sexual hypochondriacs, or than the persons who, with some real but trifling ailment of the genital apparatus, are led to believe by ignorant practitioners, or by the quacks who find this field so fertile, that their actual or imaginary symptoms are the result of youthful vices, and point to serious or even fatal derangements of body and mind. The fact that reputable and even distinguished surgeons speak of sterility and impotence, cystitis and prostatorrhœa, organic stricture and paralysis as affections *commonly* resulting from masturbation, serves to sustain this pernicious theory, which has needlessly ruined so many lives, and supported so many thousands of charlatans, and which if accepted to its full extent, would require us to believe almost one-fourth of the male population invalids or lunatics. That such troubles do occasionally result from great venereal excess, whether solitary or sexual, no one denies; but I am convinced, after having for several years paid especial attention to the observation and study of such cases, that any direct relation between masturbation, as a cause, and the diseases above mentioned, or the more serious ones often imputed to it, is an occurrence of extreme rarity; and that in the large majority of reported instances a careful examination of the evidence will show it to be quite insufficient to establish this relation. Especially is this the case in reference to organic stricture affecting the deep urethra—a region where contractions of large calibre are particularly apt to be erroneously diagnosed[1]—few, if any, unquestionable cases of this character having been reported.]

The symptom about which we are most frequently consulted is nocturnal emissions. The occasional occurrence of these is of no consequence, and the patient may be assured to that effect; but when they return more than once in a fortnight, and especially if they amount to two, three, or more, in a week, as is sometimes the case, they should receive attention. According to my own experience they are much more frequent in the middle and upper than in the lower ranks of life, and especially in those who are of studious and sedentary habits, and are anxious respecting the result of their studies. They are often associated with indigestion and turbid urine. They cause prostration both of body and mind; achings in the lower limbs and back, sometimes a flow of light-colored urine and irritability of the bladder. They are a source of great mental anxiety. This is increased greatly by the perusal of publications upon the subject, which are freely circulated among young men for the purpose of rousing their apprehensions and inducing them to resort to the authors of these publications, by whom their worst fears are confirmed, and incredible sums are abstracted for promised cure. Hence I commonly find that to the real effects of the malady are superadded others more or less imaginary suggested by what has been read, such as loss of memory, inability to fix the mind upon any subject, palpitations, dyspnœa, etc.

Treatment.—The attention to these sensations, real and imaginary, and the constant dwelling upon the matter, tends, unquestionably, to aggravate the malady. My first effort, therefore—having requested the patient to burn any book or pamphlet he may have upon the subject—is to restore a calm and less anxious frame of mind, by assuring him that great part of his apprehensions are groundless; giving him good hope of recovery, in great measure at least; recommending him to engage in outdoor amusements and to enjoy the cheerful society

[1 On the Diagnosis of Urethral Strictures by Bulbous Bougies, by J. W. White, Phila., 1877.]

of his friends; not to relinquish his reading, but to work less hard at it, especially towards night; to go to bed early and rise early. I am unwilling to keep up the idea of invalidism by prescribing medicine or particular diet, and simply warn him against overloading his stomach, as that is likely to induce the discharges. These assurances and simple directions are often sufficient; and many have told me of the relief and happiness they have derived from them. This failing, and in worse cases, more particular attention must be paid to the digestive organs and their secretions, especially when the urine is turbid; mild aperients may be required to prevent accumulations in the intestines, and a light diet must be enforced. In those who are robust, an alkali may be given at night; and in those who are weak, quinine or steel [iron]. Better than all medicines are relaxation from work, with change of air, travelling, and sea-side residence. Often, however, these cannot be carried out, or are available only for a time; and under the medical treatment the discharges are sometimes not sufficiently diminished. Perhaps the intervals between them are lengthened; and they return two or three nights in succession, instead of being more frequent and with more regular intervals. I have not found cold ablutions do much good; though washing the exterior of the glans penis, and keeping it clear of secretion, is of some service by lessening the irritability of that part.

[In cases of nocturnal emission, after having so far as possible relieved the mental depression by proper encouragement and a cheerful prognosis, it is well to lay down certain general rules for the government of the patient. He should frequently wash the genitals, particularly the glans penis, in cool water, afterwards dusting a little starch or lycopodium over the latter region; he should restrict his diet, at least until the habit has come under control, to farinaceous articles, fruits, milk, etc., making the evening meal uncommonly light and digestible; he should sleep on his side, on a hard bed, and with as little covering as he can be comfortable with; he should secure an evacuation of the bowels the last thing before retiring, and should empty the bladder once during the night—there is rarely any difficulty about forming both these habits so that they become entirely automatic; it is well for him to adopt some means by which he will be awakened on the occurrence of an erection, which takes place before the emission in all but the most advanced cases. The serious objection to the various forms of apparatus sold for this purpose is that by embracing or touching the penis they give rise to the very condition it is desirable to avoid. I have employed most of them, often with good results, but always with this drawback, until I began the use of a simple contrivance consisting of an ordinary small round basket, known as a bird-basket, and a long piece of tape or of corset-string. The tape is put through the meshes of the basket near the edge, and the latter, which should be just large enough to cover without touching the genitals, is placed over them, the tape is carried once around the waist, the two ends, following the line of the groin, are brought around the thighs to the pubes and tied over the top of the basket. By these means no unnatural heat of the parts is induced, and there is nothing to give rise to erections, whereas upon one taking place the contact of the penis with the irregular rough surface of the inside of the basket immediately awakens the patient. This would seem almost too trivial to describe, were it not that in more than a dozen cases during the last year I have found it to give the greatest relief to intelligent men who had vainly tried every other method of avoiding nocturnal erections. It must be remembered that habit is a powerful agent in causing the continuance of emissions, and that it is therefore of the greatest importance to at least temporarily arrest them. An alkaline, refrigerant diuretic should be given, preferably the acetate or citrate of potassium, to which should be added, at bedtime, 30 grains of bromide of potassium; if, as is usually the case, there is hyperæsthesia of the prostatic urethra, a full-sized steel sound should be employed every fifth or sixth day, the bromide should be given twice or three times daily and five drops of tincture of gelsemium should be added to each dose. In the great majority of cases these measures will give relief. When they fail, cauterization of the prostatic urethra, as described below, or the employment of galvanism or a faradization with a urethral electrode should be tried. Of course if phimosis, a contracted meatus, organic stricture, fissure or hemorrhoids be present, an operation should be performed for their relief. A proper marriage is the best of all remedies, and should always be recommended when the patient is of proper age, in cases where desire and erection persist, even if the latter be only partial.]

The application of nitrate of silver, by means of the porte-caustique, to the hinder surface of the prostatic part of the urethra, where the ejaculatory ducts open, is unquestionably, in some cases, an efficient adjuvant to the means just described for checking or moderating this malady. It has been employed by many persons since it was brought prominently

into notice by Lallemand ; and I do not know that mischievous results have attended its use in competent hands. Care should be taken that the instrument is sound, for the solder connecting the part which carries the caustic is liable to be decomposed. This once gave way, leaving the end of the instrument and the caustic in the prostate of a gentleman whose urethra I was cauterizing. It was voided with the urine in the course of the following day ; and, though he suffered more than was intended, no evil resulted. The caustic may be applied pretty freely, the instrument being known to be in the prostatic region by the distance to which it has been passed, and by the sensitiveness of the part, or, more certainly, by feeling with the finger in the rectum. A good deal of irritation and pain, with frequent bloody micturition and some discharge follow the operation, with, perhaps, seminal emissions at night. These subside in a few days, and the good effect is, at once, shown by a cessation of the emissions. In many cases, however, they return after a period ; requiring a repetition of the remedy, perhaps two or three times ; and in some cases no good results from it. I am aware that this proceeding is objected to by some whose opinion deserves attention, as unsafe, by others as empirical, and by others as unphysiological and unpathological. It can scarcely be regarded as unpathological, when we observe the effect which is produced on the whole length of a tube or a series of tubes by irritation at any one part of the lining membrane, especially if that part be near an orifice ; how titillation of the fauces will cause vomiting, or of the larynx coughing, or of the rectum diarrhœa and tenesmus. It cannot be very unsafe or even injurious, or we should ere this have heard of more ill-effects produced by it. Neither do I think it so empirical and unpathological as some seem to regard it, mistaking, as I cannot help fancying, the real seat of the malady, which appears to me to be in the prostatic part of the urethra more distinctly than in any other portion of the generative apparatus. I judge this to be so, because there is usually a preternatural sensitiveness of that part elicited by the passage of instruments, or by pressure with the finger. Frequently there is uneasiness or actual pain there, especially after the emissions ; and an irritation of this part by any cause is likely to induce the emissions.[1] It is the only part in which anything distinctly abnormal in the sensations is experienced ; the testes, vasa deferentia, vesiculæ seminales, show little or no tenderness or other sign of disturbance. We are, therefore, warranted in considering this part to be at fault, and in applying to it that salt which is often found to allay irritability or a chronic inflammatory condition in other mucous membranes. Above all, there is the more cogent argument that good frequently results from its use. We must not, however, be too sanguine in our expectations, for, as has been already said, the benefit is sometimes only temporary, and in some cases the treatment fails altogether. In some slight cases benefit is derived from the occasional passage of a metallic instrument into the bladder, and allowing it to remain there ten or twenty minutes. It is commonly well to try this before resorting to cauterization.[1]

[1] In each of three aggravated cases examined by Lallemand and Curling, "the mucous membrane of the prostatic part of the urethra was swollen and injected. The prostate was nearly destroyed, and converted into a multilocular abscess, or a number of alveolar cells, communicating with each other ; and the diseased mucous membrane covering it was riddled with holes, formed by a considerable enlargement of the original orifices of the gland, through which pus or altered secretion freely escaped on pressing the prostate." "One or both vesiculæ seminales were infiltrated with pus, and their walls thickened by inflammation. The orifices of the ejaculatory ducts were enlarged and abraded."—Curling, On the Testis, p. 391.

[1] *Castration in erotomania.*—The following note from Dr. Bell upon this subject in the Boston Medical Journal, vol. lxi., p. 166, and Med. Times and Gaz., gives an estimate of the effect of the operation in these and the allied cases for which it has been proposed. It is occasionally successful, but often does no good. "I have often been consulted as to tying the spermatic arteries, the vasa deferentia, and removal of the testes, in the forms of insanity connected with spermatorrhœa. I have known it done repeatedly. In one case Dr —— castrated a clean-gone onanist, who subsequently rallied, became an active man, and the doctor told me that he never met him that he did not receive his blessing for the great favor that he had conferred on him. In another case of self-perpetrated castration under a similar state of mind, entire restoration to peace of mind and energy was produced. On the other hand, in all the lunatic hospital cases where I have known it done, no valuable results have followed. At the Ohio Hospital, some years ago, it was tried on quite an extensive scale. No case of improvement followed ; indeed Dr. Awl told me that in one patient who previously was quiet and contented, a permanent and dangerous condition of irritability followed." These remarks correspond with the result of Mr. Holthouse's case read before the Medico-Chir. Society, March 22, 1859. In that case the epileptic seizures returned as before the castration. It should be remem-

Accompanying this malady, or independent of it, there is sometimes a discharge from the urethra of tenacious fluid, like white of egg, in small quantity, following the urine, or expelled during the evacuation of the feces, especially when straining is required for that purpose. This symptom causes great alarm to the patient, as he conceives that he is suffering from a continual escape of the semen. Such, however, is not the case. I have examined this fluid passed by several persons, and have never found any spermal elements in it. It proceeds apparently from the prostate gland; and its presence in sufficient quantity to issue from the urethra is an indication of a relaxed condition of the ducts of the gland, permitting the secretion to be expressed during the voiding of the urine or feces. It generally ceases or diminishes under a tonic regimen and attention to the state of the bowels.

The same trains of symptoms which follow the noxious habit just mentioned may be induced by excessive indulgence in venery, though they are not often so enduring, or attended with so much mental depression. They are not uncommon, in greater or less degree, soon after marriage. They occasionally result also from gonorrhœa, when the inflammation has extended to the hinder part of the urethra, and left a morbid irritability there. The general plan of treatment is much the same, whichever may have been the cause.

The commonly received opinion that the debility and other symptoms experienced in these cases are due chiefly to the loss of spermatic fluid is a mistaken one; forasmuch as the exhaustion consequent on the emission bears very little relation to the quantity of the fluid discharged, or to the amount of spermatic elements contained in the fluid. As the disorder progresses, and the emissions are more frequent, the proportion, indeed the actual quantity, of spermatozoa decreases, the discharge consisting chiefly of the secretions of the vesiculæ seminales and the prostate gland. The drain upon the system is rather through the nervous system than through the testicle; and the exhaustion experienced after each occasion is consequent upon a loss of nervous force rather than upon a loss of the secretion of the generative organ.[1]

[Impotence, or inability to perform the act of copulation, is, when acquired, usually due to loss or impairment of erectile power. It may be, and commonly is, caused by exhaustion of nerve force due to chronic irritation of the deep urethra or to sexual excesses. It may be purely cerebral, *i. e.*, imaginary or nervous; or it may depend upon some deformity of the organ following cicatrization after extensive ulceration. In the great majority of cases feeble erection and premature ejaculation occur, though occasionally desire and power are both absent. The additional symptoms are lumbar pains, ano-

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bered with reference to the operation in these and similar cases, that the fluid emitted is not formed, altogether, by any means, by the testes, but merely acquires its fecundating qualities from the secretion of the testes; and that, therefore, the immediate object intended by the operation—the prevention of emissions—really is not effected in many instances, at any rate for some time after the operation. The emissions are not dependent upon the testes, but upon an irritable state of the genital organs; and they may continue, and be as prejudicial, although there be little or no semen in the fluid evacuated.

Dr. Bacon, however, of the Cambridgeshire Asylum, in a paper on Epileptic Insanity (Practitioner, June, 1869), states his belief that in "seven of every ten cases of chronic epilepsy in the male sex, the genital organs are the great sources of excitation, and generally from the morbid state in which they are kept by the bad habits of the patients." He believes castration to be the only effective mode of quieting this state, and so alleviating the epilepsy and improving the mental condition in some cases, though in others careful supervision and treatment may do much good. He relates the case of a lad aged eighteen, in which the operation was followed by marked improvement in health and intelligence, and diminution or cessation of the fits; and he informs me (eighteen months after the operation) that the improvement has continued, and that since the operation, the fits have not recurred with more than a fifth of their former frequency. In another case, that of an idiot, aged sixteen, with marked sexual excitement, and very frequent masturbation, the removal of the testes eighteen months ago has been followed by great improvement in these respects.

Mr. Chapman (Med. Times and Gaz., vol. xviii., p. 377) gives the case of a great sufferer from seminal emissions, with failing health, palpitation, dimness of vision, etc., who had one testicle removed in 1840, and the spermatic artery of the opposite side tied and divided, and more than an inch of the vas deferens removed in 1841, without benefit. Three months after the last operation the remaining testicle was removed. In 1848 he felt himself far better in all respects than before the operation; his eyesight was excellent; but he still was feeble, had weakness in the loins, and was a great sufferer from indigestion and low spirits.

[1] It appears, from the observations of Lallemand, that though the semen may be abundant, and of the usual odor, the spermatozoa are liable to be deficient in quantity. This is not altogether confirmed by Liégeois, Med. Times and Gaz., Nov. 6, 1869, p. 543.

rexia, vertigo, sick headache, general debility, etc. All exciting causes of peripheral irritation should be carefully removed, as in cases of nocturnal emissions, the two conditions being closely associated; sedatives and astringents should, if necessary, be applied to the deep urethra. The sound should be passed occasionally, and the bromide of potassium and gelsemium administered until all urethral irritability is subdued. Subsequently it may be necessary to employ tincture of iron, phosphorus, cantharides, damiana, and other genito-urinary tonics, or aphrodisiacs as they are called. Cold sitz-baths, douches to the lumbar region, and galvanic stimulus to the deep urethra will also be useful in the later stages when the impotence persists, but all undue irritation has been allayed.

Sometimes these cases are very troublesome, and there is usually a more or less hurtful psychical element which militates against recovery. A favorable prognosis may generally be given, and, as a rule, it is safe to recommend marriage in all but the most aggravated cases, there being no tonic for the genital powers equal to their natural and moderate exercise. Castration is never justifiable, although it will often be demanded, not, of course, as a cure for the impotence, but as preventing the nocturnal emissions, to which the patient attaches exaggerated importance.]

The question of impotence, with its contingent—the unadvisability of matrimony—is one on which it is difficult to write, inasmuch as there is not much very definite to be written. In deciding it, it is usually necessary to allow a considerable margin for the nervousness of the patient. A quiescent state of the organs, consequent on long control of the passions, is not to be regarded as an obstacle, because they may be roused into activity when appropriate circumstances arise; and after a long continuance and frequent repetition of nocturnal emissions, the organs usually retain sufficient vigor to admit of improvement under the influence of matrimony. It has happened to me often to be consulted on this subject; and I have very rarely felt it necessary to give a discouraging opinion. In the case of one gentleman, who from early life had been subject to very frequent emissions, who had long ceased to have erections or desire, and to whom a variety of treatment, including cauterization of the urethra, conducted by different persons, had failed to give relief, my advice was that he should remain a bachelor. Very soon afterwards he married and had a family. It has been recommended that in doubtful cases the *experimentum* should be made *in corpore vili*. This appears to me to be useless as well as wrong; for the experiment thus made as a test is no real test, and, as might be expected, has ended in disappointment. I know a gentleman, in every respect, as I believe, well qualified to be a husband, and at one time anxious to be so, who has been prevented from marrying by the failure in this test, to which he, most reluctantly and needlessly, assented, in deference to the advice of an eminent surgeon whom he consulted. The indications derivable from external appearance are of little value; and suspicions based upon them have repeatedly proved to be groundless. There are certain obvious disqualifications, such as imperfect formations or diseased conditions of the necessary organs, and an entire absence of erections or desire. Where such disqualifications exist, matrimony is rarely contemplated. Where they are absent the surgeon is seldom justified in giving an unfavorable verdict; the instances being few in which, by judicious treatment, the patient may not be fitted for matrimony.

To the encouragement to matrimony it is well to add the hint that though, for various reasons, the rite may not be at first consummated, yet that, in all probability, it will be so before long. This may prevent unnecessary disappointment or despair. I have known premature separation carried out, indeed hurried on by the medical man, when there is reason to think that a little management and patience might have resulted in a happy union. The whole of this question is fraught with so much anxiety and excitement to the person concerned, that the mind is liable to be thrown off its balance, and the most deplorable consequences to ensue. In some cases, doubtless, there is cause for the anxiety; but in many the apprehensions are groundless; and happy is it if a man when thus racked with doubts can bring himself to make a confidant of, and disburden himself freely to, some judicious medical adviser, who will calmly enter into his case and acquire his confidence, who will assure him that such cases are not uncommon, and will, perhaps, give him the often quoted recommendation of Hunter,[1] to make up his mind to abstain for a time. In all such cases it is necessary to take the general state of the health into account; for any debilitating cause, such as dyspepsia, diarrhœa, mental anxiety, etc.—especially when there are phosphates or oxalate of lime in the urine—is liable to be attended with inability, which may be only of temporary nature, and will yield to appropriate treatment.

As a general rule, in the healthy person, the recurrence of desire and power,

[1] Treatise on the Venereal Disease, p. 203.

more particularly the former, decreases gradually with advancing years. Sometimes it does not cease till a late period. This, however, varies much. In those who have abused the organs, or indulged their amorous propensities to excess in early life, the cessation takes place sooner than in others. We learn that the lords of the harem are not unfrequently impotent at thirty or forty; and in this country the same occurs to persons who have been addicted to exciting the organs preternaturally by giving way to lascivious thoughts, and in other ways. Any debilitating influence, whether it be mental depression or enervating bodily disease, indigestion, phthisis, diabetes, etc., produces more or less of the same effect; and it has been remarked by Mr. Curling that the "testes of persons who die of chronic lingering diseases are almost invariably soft and inelastic. When incised, their internal structure seems to contain but few bloodvessels, is pale, apparently shrunk and dry, and the little fluid that can be squeezed from it is destitute of spermatozoa.[1] It seems also that long-continued continence induces an earlier cessation of the capability of function than does moderate indulgence. And after long disuse the attempt to rouse these organs into activity at a late period of life, even if successful, is not altogether without risk to the general health. The excitement consequent on it is liable to induce much prostration, which may be followed by paralysis, amaurosis, affection of the heart, or other disorders. I suspect there is foundation for the remark that these ill-effects are more likely to occur in the case of widowers marrying after a considerable interval, than in those who have not been before married. "Sexual indulgence late in life seems also to promote the enlargement of the prostate gland; and I know of several instances of old men being attacked with retention of urine from congestion of this organ, occurring after coition."[2]

A moderate indulgence in sexual intercourse, especially when the affections are involved, tends to promote the general health and vigor. There are cases, however, in which even this cannot be borne, and in which the nervous exhaustion that ensues warns that abstinence is necessary.

I know an instance in which an apparently healthy man, aged about forty-five, suffered so much depression, with staggering and partial loss of vision, after each connection with his wife, that, being unable to restrain himself, he urgently demanded and submitted to castration. He lived many years afterwards in the enjoyment of perfect health, and in the conviction that the mutilation to which he had submitted had been the means of preserving his visual organs, if not of saving him from general paralysis.[1]

Non-ejaculation or want of emission of semen during copulation is an occasional cause of the inefficiency of the act. A gentleman of spare frame, but enjoying good health and strength, has never been able to effect complete intercourse with his wife in consequence of this defect. Erections occur; but, however long the attempt is continued, emission does not take place. This will, however, often occur afterwards during sleep and at other times, but is not excitable by the proper stimulus. He was subject to rather frequent nocturnal emissions before marriage. There is no other symptom. A variety of treatment has been tried by myself and others who have been consulted, without avail, such as tonics, with and without strychnine, belladonna, and blisters to the perineum, the passage of a steel sound, cauterization of the urethra, and galvanism. I endeavored also to increase the irritability of the external parts by slight stimulating applications to the glans penis, the perineum, and the region of the anus. I have met with other similar cases. One under the name of Aspermatism is related by Dr. Van Buren (New Orleans Journal of Medicine, April, 1869) in which the prepuce was removed without any good result. The Traité de l'Impuissance of Dr. Roubaud and a few other cases are referred to.

Impotence sometimes follows injuries of the head. Cases of this have been collected by Mr. Curling,[2] who remarks that when it depends upon that cause, "the prospect of relief is far from being promising. The event itself is one of the last to be detected, and is rarely perceived till all

[1] Mr. Gulliver (Med.-Chir. Trans., vol. xxvi., p. 93) finds the seminal tubes in old age and after lingering diseases "often more or less obstructed by fatty matter, which occurs in free globules, and in more equally-sized and minute molecules, aggregated into comparatively large, rounded, or irregular masses, nearly opaque, and of a brown or dull yellowish color."

[2] Curling, p. 370.

[1] I may add that for a year or more this gentleman continued, as in the instance recorded by Sir A. Cooper, to have connection with his wife and emissions much as before the operation, though less frequently; so that his wife was not aware of any change till he informed her of what had been done. After about a year desire gradually ceased. The good effect here commenced soon after the organs were removed, although the excitement and emissions continued for some time. Another man, who had lost both testes, told me that loss of desire and power followed very soon.

[2] Diseases of the Testis, pp. 63, 364. I have recently seen a case of complete impotence consequent on a jar to the spine caused by a railway collision.

treatment of the injury has ceased, and the patient is in progress of recovery. In some instances it is first announced by the visible wasting of the testicles. When otherwise, however, the surgeon must not despair of the patient regaining his sexual powers as the other effects of the injury disappear." Sometimes it is the result of cerebral imperfection, as, occasionally, in idiots, or of some congenital deficiency of that combination of forces which is requisite for so complicated a process. This constitutional impotence is not necessarily associated with any discoverable imperfection in the organs, or any obvious defect in bodily formation. Indeed, it may be associated with full intellectual vigor, and a physique, in other respects, sound and strong. Such cases are, however, rare. The external indications of virility do not often continue when the power is actually and irrecoverably gone.

[Sterility in the male depends upon an absence of fertile semen or an inability to deposit it in the upper part of the vagina. A man may be able to perform the sexual act perfectly, but if spermatozoa are absent from his semen he will be sterile; or if as a result of stricture of the urethra or of occlusion of the ejaculatory ducts the semen is unable to find exit, the same condition prevails. An absence of excitability in the spinal centre governing ejaculation, or a diminution in the sensitiveness of the nerves of the penis, may likewise produce sterility.

The treatment in obstructive sterility is directed to the removal of the cause. Stricture should be dilated or divided; if phimosis exist circumcision should be performed. In the other varieties of sterility the cure of any inflammatory or hyperæsthetic condition of the prostatic urethra, followed by a tonic and stimulant course, including iron and strychnia internally, cold douches, galvanism, etc., is the line of treatment indicated.]

Atrophy of the Testicle

Has already been several times alluded to in the preceding pages, with the remark that it does not usually take place although the function of the organ is long suspended, or, even, when it has been lost in consequence of obliteration or destruction of the vas deferens. Neither is it commonly produced by the pressure of hydrocele; although it sometimes is caused by the contraction of lymph effused in chronic hydrocele, or more frequently of the lymph effused in hematocele. One of the most common causes of atrophy has been stated to be acute or chronic inflammation—spontaneous, syphilitic, or from mumps—of the glandular substance of the testicle, with effusion of lymph, or pus, into the intertubular tissue; the tubules being compressed and destroyed by the effused products both during their formation and during their subsequent contraction. The same result may follow excessive venery, drinking, self-abuse, or anything which is productive of long-continued depression and disorder of the general health; also injuries of the head, paraplegia, and elephantiasis of the scrotum. Although injury to the duct produces no effect of the kind; yet, as we might expect in the case of an organ so peculiarly circumstanced with regard to its circulation, deriving its blood from a long distance through a single channel, and having very few anastomosing currents to fall back upon, it is very sensitive to any impairment of its vascular supply. Thus Wardrop relates that both testicles were absorbed in a man who died of an aneurism of the aorta, obliterating the spermatic arteries; and ligature of the spermatic artery will cause complete wasting of the gland. Varicocele also is sometimes attended with an impairment of the nutrition of the testis; and operations obliterating the veins in varicocele have been known to produce the same result. The atrophy usually extends more or less to the vas deferens.

In elderly persons I have found the testes rather small and flaccid, but in other respects healthy, with sometimes thickening and induration of the epididymis, and thickening of the vasa deferentia, with opaque white spots in their walls. [Senile atrophy is the result of fatty degeneration of the tubuli seminiferi, which occurs slowly as the sexual power diminishes with advancing age.] It has been already observed that the semen usually retains its fecundating qualities. It is possible that the pressure of a hernial pad or bandage may interfere with the functions of the testicle, but it is certain that it very rarely does so.

Irritable and Neuralgic Testicle.

About the period of puberty the testicle is frequently tender and irritable, so as to be pained by a slight touch or by the chafing of the trousers in walking. It does not swell or present any indications of inflammation, but is a source of a good deal of annoyance, necessitating confinement from active exercise and out-door amusement. This condition usually subsides in a short time, and may be relieved by a suspensory bandage, or an evaporating lotion if the part be hotter than natural. The same condition may occur at other periods of life, more particularly in persons of delicate sensitive, and irritable temperament,

or in those who have been addicted to self-abuse.

[It frequently results from ungratified sexual excitement, is attended with the same sympathetic pains, extending to the groin and perineum, and sometimes nauseating, as are noticed in a commencing epididymitis, is accompanied by a plethoric or congestive condition of the organ, and in such cases is always relieved by regular sexual intercourse.]

It has occasionally proved a very obstinate affection, and has been a source of so much distress to the patient as to lead him to beg for removal of the organ. Sir A. Cooper was induced by the urgent request of the patients to perform castration in three cases of the kind; and other surgeons have done the same. Such a procedure is, however, warranted only by very exceptional circumstances. Usually the malady subsides under attention to the general health. It is necessary to inquire into minute particulars respecting the state of digestion, the action of the liver and bowels, the character of the urine, the action of the skin, etc.; for where there is a tendency to irritable testicle, slight disturbances of other organs will induce it. To rectify anything wrong that may be discovered in these functions is the first point. Secondly, it is necessary to improve the general state of the health by out-of-door exercise as far as possible, by moderately nutritious diet, and perhaps by tonics. Some good may be effected by local applications, cold sponging, a suspensory bandage, or anodyne applications.

Neuralgia may occur in the testicle from the same causes as in other parts; such as a source of irritation in an adjacent region, a stone, or other disease, in the kidney, ureter, or other part of the urinary apparatus, varicocele, a disordered state of the stomach, liver,[1] or system; or a depressed condition of the health, especially if that be associated with malarious influence. In the latter case the pain usually comes on periodically. [The pain may be gouty or rheumatic in its origin.] The organ itself may be quite sound.[2] [The left testicle is most commonly affected.] The pain varies in character and severity, being sometimes dull, at others darting and so severe as to cause the patient to roll on the floor in agony and covered with perspiration.

The treatment will be the same as for the neuralgia in other parts, varying with the exciting cause and the state of the health. When it is periodic, quinine and iron are likely to be beneficial. Of local measures, the hypodermic injection of a small quantity of strong solution of morphia into the testicle or the tissue immediately investing it, offers the best prospect of success, if we may judge from its effects in relieving neuralgia in other parts.

Varicocele.

The disposition of the spermatic veins to enlarge is such as to cause varicocele in about one male adult in ten. It is due to several causes: to the size and winding course of the veins near the testicle; to their numerous anastomoses, here and in the lower parts of the cord, which interfere with the efficiency of the valves, and enable fluid injected into them to pass readily from above downwards; to the loose inelastic tissue in which they lie affording them little support; and to their passage through the oblique inguinal canal, where they are frequently subjected to pressure during the action of the abdominal muscles; and to the length and comparatively small size of their efferent trunks. The causes usually assigned for the predisposition to varicocele on the left side being so much greater than the right, viz., the slightly lower position of the left testicle, the angle of junction of the left spermatic vein with the renal, and its relation to the sigmoid flexure of the colon, do not seem to me quite sufficient; but I have none other to suggest.

[A quite sufficient anatomical explanation of the preponderance of left-sided varicocele is found in the absence of any valve in the left spermatic vein at its entrance into the corresponding renal vein. This, taken in conjunction with the causes just mentioned, accounts for the unilateral character of the disease.]

The disease consists simply in an increase of the size and tortuosity of the veins, with a loss of elasticity and contractility, and more or less increase of thickness of their coats; the latter change

[1] Sir B. Brodie (Med. Gaz., vol. xiii., p. 621) mentions the case of a gentleman in whom the neuralgic pains were usually preceded for two or three days by clay-colored evacuations, pains in the head, etc. In another case there was a small projection of the epididymis; and whenever this particular part was touched he felt a sensation which he compared to that produced on biting on the exposed nerve of a tooth.

[2] That it is not so always is proved by the case mentioned at page 921, where a small quantity of pus was found in the epididymis. In a case related by Mr. Ludlow, the patient, aged twenty, had neuralgia for six years, originating in an injury. Mr. Stanley excised the testicle; the tunica vaginalis was thickened and adherent, and the epididymis changed into a firm white substance.

depending upon an addition of low fibrous tissue, which usually accompanies the enlargement of vessels and the diminution of their elastic and contractile elements. They may be further thickened by chronic inflammation, and the formation of lymph in their coats; and phlebolithes are sometimes found in their interior. The degree of enlargement varies much. It may be so great as to fill the scrotum and conceal the gland. This is, however, rare. It is greatest near the testicle, diminishes towards the inguinal canal, and ceases in the canal; so that the spermatic vein at and above the internal ring has its natural size. At least that has been so in the cases I have dissected. The affection is rarely productive of any decidedly injurious effect upon the testicle, or upon the character of its secretion; though, when there is any great dilatation of the veins, the organ is often somewhat smaller than that on the other side; and in a few instances it has been so wasted as to be scarcely distinguishable through the scrotum.

[Opinions are at variance upon this point. Many of the cases cited in support of the assertion that varicocele produces atrophy of the testes must be excluded on account of the traumatic origin of the varicocele. Mr. Gould very justly says: "Wherever there is a history of injury or inflammation, it is impossible to say that the change in the testicle is not the direct result of such injury or inflammation." The alleged cases of atrophy are of three kinds: cases of arrested development; cases of very slight lessening in size; cases of extreme softening and wasting of the gland. The latter class is open to great doubt, the recorded cases being vague as regards the presence or absence of traumatic and inflammatory influences.]

The affection usually commences at about eighteen or twenty, and often is not recognized till the swelling attracts attention. It may be induced or aggravated by sudden exertion or straining at stool, by long walking, or standing, or riding.

It is easily known by the feel of the soft worm-like coils of dilated veins near the testicle, and extending to a variable point above it. The swelling is inelastic, increases after long standing, and towards the end of the day, and diminishes in the recumbent posture. There may also be a slight impulse on coughing. In these respects, and in its position, it resembles hernia. Still, had I not known a case in which one of the most eminent surgeons in the metropolis made a mistake between the two affections, and persevered in it, I should scarcely have thought it worth while to say a word respecting a difficulty of the diagnosis between the two affections. The feel of the swelling, its slow and incomplete disappearance when the patient lies down, although the inguinal ring is quite free, and its reappearance in the erect posture, although moderate pressure is maintained upon the canal, furnish sufficient means of distinction. The skin is often thin, so that the dark color and the outline of the dilated veins may be seen through it. The affection is usually

[Fig. 512.

Varicocele (Bryant).]

devoid of pain and tenderness. Sometimes, especially when it first appears, or when the patient's attention is first directed to it, it is attended with a sense of weight or uneasiness, or it may be actual pain; and it may be tender, and a source of much discomfort. As in the case of varix of the lower limbs, there are times during which, without perhaps any obvious reason, the swelling increases; and at these times there is liable to be more pain than at others.

Treatment.—In the greater number of cases the swelling attains a certain moderate size, and then ceases to increase or to be the source of any pain, inconvenience, or detriment to the organ. It is not usually, therefore, necessary to adopt any treatment, and scarcely worth while even to use a suspensory bandage. The patient may not be conscious of the existence of the varicocele, or will, probably, soon forget it. During the periods in which it is uneasy, painful, or tender, the part should be supported by some kind of bandage, the recumbent posture should be maintained as much as possible, and regular action of the bowels ensured. A spirit-lotion, applied as in cases of epididymitis, will also give relief. [Mr. Morgan's suspensory is a very useful little apparatus, consisting of a bag which may be laced tightly about the affected testicle, and from the end of which hang two tapes or suspenders. When the bag is in position, these are brought up and tied to a bandage surrounding the body. In this way the bottom of the scrotum is turned

upward and the veins are kept empty.] When the discomfort continues, it is necessary to try other means, such as washing with cold water, attention to the general health and state of the bowels, and light clothing about that region. These failing, a portion of the scrotum has been excised in some instances, it is said, with success, but in others with only temporary relief, so that this is scarcely to be recommended. The less severe plan of lessening the scrotal bag by drawing a portion of it through a ring made of soft silver and covered with wash leather, and then preventing its escape by pressing the sides of the ring together,[1] may be tried; for, if it fails, no harm will have been done. [This is by no means certain, the included tissues having been known to slough.]

The best means of affording relief in troublesome and painful cases of varicocele is a well-adjusted truss with the pad upon the external ring. It should press with a moderate amount of force, so as to influence the spermatic veins, diminishing their calibre, and preventing a sudden reflux of blood during exertion and straining, but not so as to affect the artery. The trusses which buckle round the waist, with a pad secured upon the part by means of an under-strap, answer, in some cases, better than the spring trusses, being less liable to displacement. The benefit afforded is often greater than might have been expected. Mr. Curling gives instances in which the varicocele was quite cured after the truss had been worn some months, and in which the testicle, partially atrophied before the treatment began, regained its natural size. In other cases it fails, owing, perhaps, to the difficulty of keeping the pad properly applied.

Various plans of obliterating the veins have been tried, such as compression by forceps fixed on the scrotum, division with the knife in the ordinary way and subcutaneously, ligature by means of needles with thread twisted in figure-of-8, and subcutaneous ligature; also ligature and incision combined. The incision and the ordinary ligature have been discarded on account of the serious results that occasionally ensued.

[Although formerly the dangers of surgical interference with veins were much over-estimated, there can yet be no doubt that embolism, septicæmia, and diffuse thrombosis are more frequently sequelæ of wounds of veins than of arteries. There have been enough instances of grave, and even fatal results, from these or similar operative procedures to establish the fact that they are not without danger.

Gant mentions diffuse inflammation and sloughing of the scrotum, suppuration of the testicle, phlebitis, pyæmia, and death as among the consequences of the operation; Erichsen records two deaths from the twisted suture; Sir E. Home had one nearly fatal case, and Gross one death after ligature; Escallier gives two fatal cases of phlebitis, and Curling speaks of three cases of serious results, two of which were fatal. Gould says that, some years ago, the censor of one of the chief London hospitals died of pyæmia after Lee's operation.]

The best modes appear to be Ricord's subcutaneous ligature,[1] and the subcutaneous ligature at two points, the veins being subcutaneously divided between them, as effected by Mr. Lee. [At a meeting of the Royal Med. and Chir. Soc., Jan. 15, 1881, Mr. Lee read a paper, in which he advocated the removal of a portion of the anterior skin of the scrotum, and subsequent division of the veins which are to be obliterated. The operation is performed through the wound in the skin. The veins are temporarily compressed, divided and sealed with the black hot cautery. The ligatures and acupressure needles are then removed, and the wound sewed up. He says he has performed it in a large number of cases without producing septic poisoning in any instance. The patient is allowed to follow his usual avocations in three or four days. Agnew describes, as follows, the operation which he has practised for twenty years without having had an alarming symptom or witnessed an instance of atrophy of the gland. The cord is grasped between the thumb and the index and middle fingers,

[1] Suggested by Mr. Wormald in his lectures, and in Medical Gazette, vol. xxii., p. 194.

[1] The following description of the operation is given by Mr. Curling: "The vas deferens being separated from the mass of veins, and the latter being pinched up with a fold of the scrotum, a needle set in a handle with an eye near the point, armed with a double-looped thread, is to be passed beneath them. When the needle has traversed from one side to the other, the loop is to be drawn out, the needle retracted, and the veins let go, the skin alone being now held up. A second needle, similarly armed, is then to be passed through, over the veins, entering at the same hole by which the first needle was thrust out, and emerging at the same hole by which it entered. The second loop is next to be drawn out, and the needle withdrawn. The bundle of veins is thus included between two double threads, of which one passes over and the other beneath it. The ends of the thread on each side are then to be passed into the loop of the other, and now, by drawing these ends in opposite directions, the vessels are tied beneath the skin." "The vessels are divided, and the ligatures come away in from the tenth to the twentieth day."

about an inch below the external abdominal ring, and slid backward and forward until the vas deferens is discovered and slipped behind the remaining constituents of the cord. This duct, by its hard wire-like feel, is readily recognized, and, as it is pressed back, the artery with which it is closely associated accompanies it. If the manipulation has been successful the veins are now in front of the grasp of the thumb and index finger, and the vas deferens and artery are behind it. A stout acupressure needle should now be thrust through the cord between the veins and the duct. A needle armed with a double hempen thread, well waxed, is then entered at one of the perforations made by the pin, passed in front of the veins, between the latter and the skin, and made to emerge at the other perforation of the pin. The operation is completed by slipping the loop of the double ligature over one end of the pin and tying its free ends over the other, during the tightening of which both extremities of the thread slip within the integument, and become strictly subcutaneous. On the seventh day the pin is withdrawn and the ligature removed. By this plan the thread can be detached at any time, without waiting for it to cut through the included vessels.]

Each of these measures has led to great relief, or a cure, in several instances; and I do not know that any fatal results have occurred. In some cases no good has followed. It must be borne in mind that all plans for obliterating the veins are liable to be productive of impairment of the nutrition of the testicle; and accordingly, we find that, in some instances, atrophy of the organ has followed the operation. This may have been caused by the inclusion of the spermatic artery in the ligature, an accident that cannot always be avoided, and the liability to it constitutes an objection to the several operations; but the veins are also essential, and if all, or nearly all of them be obliterated, it is clear that new currents must be established, or the circulation, and consequently the nutrition of the organ will be impaired.[1] For this reason, therefore, an operation should not be hastily undertaken; and another reason for delay is furnished by the fact that the pain and inconveniences resulting from varicocele often, indeed, commonly, subside after a short time, the patient becoming accustomed to and forgetful of his complaint. I need hardly say that an attempt to obliterate the veins is better than castration, which the continued distress has induced some patients to request and some surgeons to perform.[1]

[Mr. Pearce Gould formulates the indications for an operation for the permanent or radical cure of varicocele as follows: 1. When the testicle is atrophying. 2. When the varicocele is double, especially if an examination of the semen shows an absence of spermatozoa, or the patient, being married, is sterile. 3. When the opposite testicle is lost or useless from tumor, orchitis, epididymitis, or injury. 4. When the varix is large and increasing, in spite of palliative treatment. 5. When the varix causes much pain, or interferes with proper exercise and necessary work. 6. When it is the occasion of marked mental depression. 7. When the varicocele prevents acceptance for either of the government services.

He describes (Lancet, July 17, 1880) an operation which consists in subcutaneously dividing the veins by means of a platinum wire heated to a red heat by electricity. He claims that by these means we avoid the pain which follows the other operation, and, at the same time, employ a method which is simple, effectual, introduces no new danger, and is free from sources of irritation. In Jan., 1881, he reports eleven cases with perfectly satisfactory results in every case.]

Tumors in the Spermatic Cord.

Fatty tumors are occasionally found in the cord, and, like the cysts in the same situation (p. 909), being movable to some extent in the course of the cord, they are with difficulty distinguished from hernia. I found this to be so in the case of a rather stout gentleman who, four years ago, had

[1] Delpech was assassinated by a man whom he had cured of double varicocele by tying the veins some years before. The man's testicles were found wasted and soft after death; the same effect upon the organ has been observed in other cases. The frequent reports of cases of operation for the cure of varicocele induce me to repeat the observation of Sir A. Cooper, that "varicocele should scarcely receive the title of a disease; for it produces, in the greater number of cases, no pain, no inconvenience, and no diminution of the virile powers." I cannot but think that operations are sometimes performed rather hastily and unnecessarily for this affection.

[1] M. A. Verneuil describes two cases of subcutaneous erectile venous tumors of the scrotum, dependent upon enlargement of the subcutaneous veins of the scrotum, and showing a tendency to spontaneous inflammation. They may be destroyed by cauterization or extirpation (Gaz. hebd. de Méd. et Chir., Sept. 16, 1859, and Ranking's Abstract, xxxi., p. 176). M. Escallier relates two cases of varicose tumor of the scrotum (apparently variocele more circumscribed than usual), simulating hernia, in which spontaneous inflammation with suppuration took place and proved fatal. Mém. de la Société de Chirurgie de Paris, vol. ii., p. 66.

a swelling, about the size of a walnut, near the external ring. It was doughy, not tense or fluctuating like a cyst, but felt more like a hernia; and it passed a little way in and out of the canal. It could not, however, be returned into the abdomen; was influenced by traction upon the cord; and the finger and thumb could be approximated behind it in such a manner as to prove that it was not continued into the abdomen. I judged, therefore, and another surgeon, who examined it with me, agreed, that it was a fatty tumor of the cord. Since that time not much change has taken place in it.[1]

Malignant tumors may form in the cord, not only as a sequence of disease of the testicle, but independently of it.[2]

The Affections of the Vesiculæ Seminales

Have received very little attention from pathologists and surgeons—less than they deserve,—for these bodies are not uncommonly diseased in company with the testicles or independently of them; and such diseases may induce or aggravate inflammation of the bladder, and be productive of other ill effects. It is to be observed that the seminal vesicles lie within range of the finger passed into the rectum; so that their condition may, in most instances, be determined with tolerable certainty.[3]

They seldom are the subject of spontaneous inflammation, but sometimes become inflamed secondarily, as in gonorrhœa; and the symptoms are much the same as when the prostate is inflamed, viz., uneasiness about the perineum, pain in defecation, frequent and rather painful micturition, or retention, emissions at night, attended with pain, and the fluid stained with blood. The finger in the rectum discovers the vesicle, on one or both sides, distinctly swollen and tender. In two cases of blennorrhagic orchitis, where the patients died of other disease, M. Goussail found the seminal vesicles swollen and gorged. I do not know of the affection terminating otherwise than in resolution; and I am not acquainted with anything in these parts corresponding with the chronic orchitis, syphilitic or other, of the testicle. They are, however, not unfrequently the seat of scrofulous disease; and in cases of scrofulous affection of the testicles it is well to examine the state of the seminal vesicles; and they will sometimes be found considerably enlarged and firm, from deposit in their canals, although there may be no symptoms of such a condition. The changes that take place correspond precisely with those that occur in the epididymis; that is to say, the tortuous component tubes become enlarged and distended with scrofulous matter, partly infiltrated into the lining membrane, and partly formed of morbid and accumulated epithelium, while the connecting areolar tissue of the tubes remains sound. Subsequently this may be destroyed, if softening and suppuration take place. I have dissected several specimens of this; and some of them are in the Pathological Museum of the University of Cambridge.

The disease is only to be distinguished by examination with the finger in the rectum; and for want of this exploration it escapes notice in many cases. The organ will be found enlarged, perhaps tender, and more or less firm, according to the condition of the morbid deposit in it. The prostate is likely to be the seat of tuberculous disease at the same time. It has been so in the cases that I have dissected. The treatment corresponds with that for scrofulous disease in the testicle and other parts.

I have in several cases known a chronic enlargement of the vesiculæ seminales analogous to the affection of the prostate in elderly persons, and attended with corresponding symptoms of irritation of the bladder. Indeed, I have discovered it when examining the rectum under the impression that there was enlargement of the prostate. What relation, if any, this condition of the vesicles may have had to the bladder-symptoms, I cannot tell. I first found it in dissecting the bladder of an old man who died after long-continued prostatic affection with retention. The prostate was enlarged, and the seminal vesicles were two or three times as large as natural, of very firm structure, so as, in consistence, almost to resemble scirrhus; the component canals were large, and the investing areolar tissue much hypertrophied and indurated.

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[1] In the Museum of the College of Surgeons (No. 2461) is an oval fatty tumor, four inches in length, embedded in the tissues of the spermatic cord an inch above the testicle. In some instances the tumors have closely resembled omentum, and have even, it appears, been contained in a sac like a hernial sac. Curling, p. 453.

[2] Museum of College of Surgeons, 2462, 3. No. 2367[20] is described as a large fibro-plastic tumor of the cord.

In the Catalogue of the Museum of Mr. Heaviside is the entry of a "stone found in the cellular substance of the spermatic cord of a man who died of strangulated hernia." Gamgee, loc. cit., p. 181.

[3] It appears that a thesis has been written on inflammation of the seminal vesicles by M. Eugène Rapin in the Moniteur des Sc. méd., 1859, No. 42. Canstatt's Jahresbericht, 1860, vol. iii., p. 284.

I have now a man above seventy under my care, suffering from severe irritation of the bladder, amounting to incontinence, in whom the prostate is little, if at all, enlarged; but the seminal vesicles may be felt beyond it of twice their natural size and firmer than usual. In other instances I have found on the dissection of the vesiculæ seminales in elderly persons, that the component tubes were dilated, but actually reduced in extent and length, while the connecting and investing areolar tissue was thickened.

Although in the case of imperfect development of the testes at page 893 the seminal vesicles were very small, consisting of few coils of tubes, usually the condition of these bodies shows no especial relation to that of the testes. One testicle may be wanting or imperfectly developed, or the vas deferens may be only partially formed, or have been divided, or become obliterated; yet the vesicula seminalis on that side is commonly as large as on the other side. It is in such case filled with its own secretion unmixed with spermatozoa. This corresponds with what has been said (page 893) respecting the presence of the ejaculatory power in persons whose testes were imperfect or absent.

Affections of the Scrotum.

Œdema.—The loose tissue of the scrotum renders it very liable to œdema, which is often met with in new-born and young children, resulting in them, commonly, from some slight irritation of the skin, and usually subsiding under careful attention to keep the part dry and powdered.[1] In after life it is easily induced by inflammation or suppuration of adjacent parts, especially by abscess connected with the urethra; and sometimes it is the herald of, or attendant upon, general dropsy, resulting from disease of internal organs. It is usually dependent upon some such cause, general or local, and subsides when that cause is removed. Great relief, however, may sometimes be afforded, and sloughing of the part prevented, by punctures with a needle at various points, which allow the serum to drain off, and are rarely followed by any of the ill effects which are likely to ensue if incisions be made.

[Œdema begins in the lower part of the scrotum and gradually ascends, obliterating the normal rugæ, and causing the skin to become blanched, shining, and translucent. It has a doughy, inelastic feel, pits on pressure, and is not confined to one side. These characters serve to distinguish it from hydrocele, the only affection with which it is at all likely to be confused.]

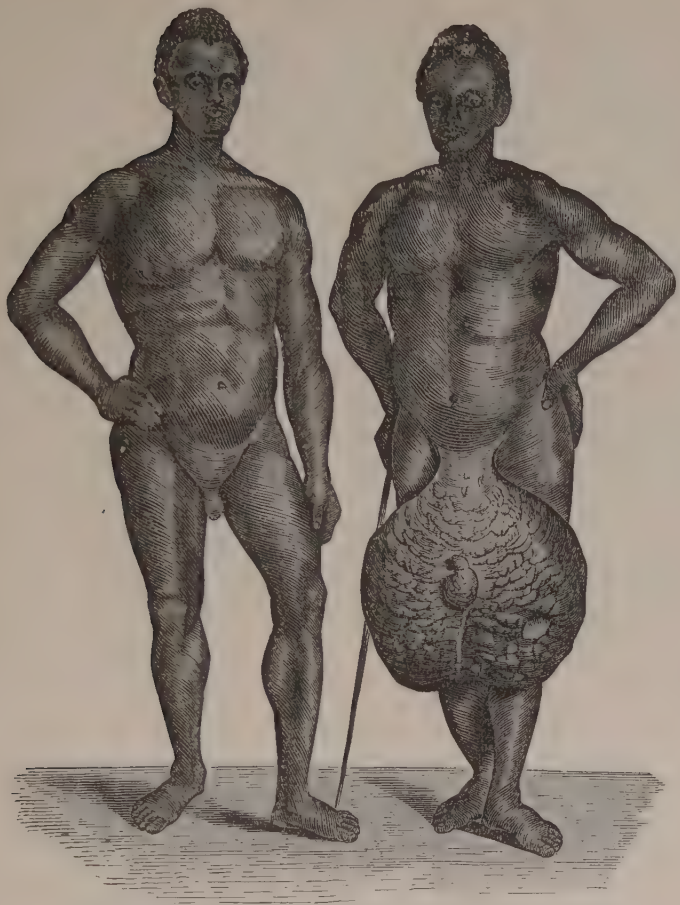
Inflammation.—Its loose structure and its comparatively isolated pendulous position also render the scrotum an easy prey to inflammation, erysipelatous or other, which is apt to be excited by slight causes, such as small wounds or abrasions, boils or small abscesses in or near it. The inflammation quickly spreads, causing rapid œdema; and, if the patient be in a low state of health, it may go on to diffuse suppuration and sloughing of the skin and subcutaneous tissue. Mr. Liston[1] described cases of "rapid distension of the scrotum with serosity" ["acute anasarca of the scrotum"] supervening generally upon an abscess or ulcer, perhaps trifling, in the perineum or groin; and he found that destruction of the cellular tissue and skin could be arrested only by very early and free incisions. Sometimes inflammation is excited by the dribbling of urine; or it may arise without any apparent cause. An abscess rarely forms in the scrotum. When suppuration takes place, it is usually diffuse, and may be recognized by the hard feel and angry appearance of the part, added to the dry tongue and low feverish state of the patient. This result, as well as sloughing, may commonly be averted, where the constitution is sound, by rest in the recumbent position, warm fomentations, and such diet as the condition of the patient requires. If suppuration takes place, or if the discoloration of the skin threatens gangrene, incisions should be made; and it may be necessary to give wine and ammonia to maintain the strength. Under careful treatment the affection, even in severe cases, rarely terminates fatally. After large portions of the scrotum have been destroyed, and the testicles and spermatic cords have been laid bare, granulation and cicatrization proceed with surprising rapidity, and, owing to the abundance of loose skin, the breach is healed without much detriment.

Though so liable to slough from inflammation excited by a local cause in enfeebled persons, the scrotum is very sel-

[1] It is, however, sometimes more troublesome and dangerous. I was called to a case of the kind, in which the inflammation and swelling were very great, like erysipelas, and extended to the penis and adjacent parts, causing retention of urine, and proving fatal in a few days. Two similar cases, also fatal, are given in the Med. Times and Gaz., vol. xii., p. 364.

[1] Medico-Chirurgical Trans., vol. xxii., p. 288. Mr. Erichsen (Med. Times and Gaz., vol. xxi., p. 211) gives a case of acute inflammatory œdema of the scrotum, supervening on a perineal swelling, which first appeared during gonorrhœa, and ending in gangrene. The whole scrotum sloughed, laying bare the testicles.

[Fig. 513.



Elephantiasis scroti before and after operation for extirpation.]

dom the seat of mortification from frost-bite. Cases of this kind have, however, been witnessed by Sir A. Cooper and Mr. Curling.

Elephantiasis of the scrotum, so rare in this country,[1] is very common in tropical climates, especially Bengal, the East and West Indies, Ceylon, Egypt, and South America. [The case of Dr. Picton, of New Orleans, which is figured in the cut, before and after extirpation, is one of the best known of those which have occurred in this country.] It consists in a thickening with some change of structure—a modified hypertrophy—of the skin and other tissues of the scrotum, which are, in addition, infiltrated with serum or oily matter, the latter being sometimes so abundant as to give to the whole the characters of an oleaginous mass. The cremaster has been found thickened, and

[1] One of the best-marked cases of the tuberculated form of the disease that has occurred in this country is related by Mr. Isaacson, in vol. xviii. of Prov. Med. and Surg. Trans., p. 244. In the Museum of King's College Hospital is a specimen of elephantiasis of the scrotum removed by Mr. Fergusson from a man who had never been out of this country. The mass weighed 5 lbs. 15 oz.; the disease was the result of inflammation consequent on a blow. Cases have also been recorded by Liston, Operative Surgery; Brett, Lancet, July 11, 1846. Cases occurring in other parts of Europe have been related by Delpech, Lamy, Delmas, Auvert, and Nögell.

In the Museum of the College of Surgeons, No. 2466, is an enormous mass of scrotal elephantiasis, measuring 42 inches in circumference, including the penis and testicles, consisting chiefly of compact structure like mammary gland, and covered with coarse skin, in parts warty and knotty. It was removed by Mr. Liston from a man aged twenty-two, who recovered.

the spermatic cords elongated; but the testicles are usually healthy. Sometimes there is hydrocele. The disease, which is probably essentially of a low inflammatory nature, commences, in some cases, at one point, and thence spreads gradually over the scrotum; or there may be tumefaction of the whole bag, which subsides in part, and then returns, and finally becomes permanent and increases. It may be excited by some local cause, such as a fistulous tract; but more commonly there is nothing of the kind. In some cases the part remains smooth; in others it becomes uneven, tuberculated, and corrugated; but in either case it has little or no tendency to ulcerate, unless it be in consequence of abrasion when it has acquired great bulk. It simply goes on increasing, without pain, remaining dry on the surface; and the increase is of a very determined character, no local or general treatment seeming to have much influence on its progress. The mass, in course of time, attains to enormous size, weighing fifty, a hundred, or even a hundred and fifty pounds, and proves fatal by its distressing weight, or perhaps by ulceration and discharge supervening. Several of the patients have been observed to have ichthyosis in other parts of the body.

Treatment.—In the early stage, especially if the disease assume at all an acute form, it may probably be arrested by measures calculated to allay chronic inflammation of the skin, of which the most important would be pressure. It is, however, by no means certain that such treatment would be effectual; and much time should not be lost in the attempt, otherwise the mass will attain to such dimensions as to render the radical treatment dangerous. Unfortunately, the case is commonly not seen by the surgeon till the period has passed at which curative means are at all likely to be efficient, and removal offers the only prospect of success. This has been done by Mr. Esdaile, in 161 cases, with the loss of only five per cent. When the tumor is of moderate size, therefore, its removal is a matter of little danger; and the testicles and penis may be dissected out and saved. When the mass has attained to great size—more than forty pounds—the hemorrhage consequent on the division of the vessels feeding so large a mass is frightful; and it is necessary to cut the tumor away as rapidly as possible, without regard to the genital organs; and with all care the patients have in some instances sunk at the time or soon afterwards from loss of blood.[1] [An Esmarch bandage should be applied to the mass from below upward, and the belting secured around the base of the growth. Each vessel should be tied as soon as divided. It should be remembered in operating rapidly in these growths that a hernial sac may complicate the case. In one instance, such a sac was accidentally opened during excision of the elephantiasis.]

Tumors of the scrotum are rare. Of *cystic* tumors I have met with only two remarkable cases.[1] *Fatty* tumors seem to be rather less uncommon.[2] Both have proved very difficult of diagnosis. Of *fibrous* tumors several instances have been collected by Mr. Curling: and others have been related. They originate in the areolar tissue, and grow slowly and without pain. Some are very dense, resembling the fibrous tumor of the uterus, and, like it, undergoing occasionally calcification at various parts of the mass; others are more succulent. They may attain to enormous size, weighing twenty, thirty, or more pounds; and have been removed successfully when of this magnitude. Some of the cases have been of the recurrent kind of fibrous or fibroid.[3] [One

[1] See a case by Mr. H. Walton, Med. Times and Gaz., vol. xix., p. 132, in which he tied the scrotum in small segments close to the trunk, removed the mass below the ligatures; and then, as each strangulated part was liberated, the vessels were secured. The scrotum was eight or nine pounds in weight. The patient recovered.

M. Clôt-Bey has given his extensive experience respecting this malady in his Histoire d'une Tumeur éléphantiaque du Scrotum, Marseilles, 1830; in the Annales de la Médecine physiologique, 1834; and in the Mém. de la Société de Chirurgie de Paris, vol. iv., p. 547. He regards it as a local affection distinct from lepra; the principal phenomena being tumefaction, hypertrophy, and inflammation of the skin and subcutaneous tissue; the tuberculous condition of the skin being only an occasional attendant. He believes it incurable, except in quite early stages; and the patient will then rarely submit to the requisite treatment. Extirpation of the part should therefore be practised without delay.

[1] A transparent cyst, of the size of an apple, containing unctuous yellowish fluid, situated in the cellular tissue of the scrotum, connected with the skin, and supposed to have originated in the sebaceous follicles of the skin, is described by Dr. Bauchet; Archives gén. de Méd., 5e série, vol. ii., p. 71. Mr. Curling describes and represents a cystic mass, like cystic sarcoma of the breast, removed from the scrotum of Mr. Crompton, of Manchester.

[2] Trans. of Path. Society, vol. vi., pp. 230 and 232, xvii., 176, and xviii., 186; Curling, On the Testicle, p. 490; Kimball, in Boston Med. and Surg. Journal, Oct. 17, 1861.

[3] This was so in a case operated on by Mr. Fergusson; a large fibrous tumor was excised from the scrotum, and three years afterwards it recurred, and was of the size of a child's

enchondroma of large size has been reported.]

We read now and then of large calculi which have been formed in the bladder finding their way into the scrotum, and escaping from it by ulceration[1] or being excised.

Cancer of the scrotum is almost always of the epithelial kind,[2] and usually confined to chimney-sweeps.[3] It is much more common in this country than in others, but appears to be on the decrease here—perhaps owing to the more general use of machines for sweeping chimneys. In its origin, structure, course, and implication of adjacent glands, without involving more distant regions, it corresponds with epithelial cancer of the skin in other parts. Thus, it commonly begins in a small soft tubercle or wart on the scrotum, oftenest near the lower and fore part. This tubercle appears to be of simple nature, and may remain for a long time without change, only increasing very slowly. Sooner or later it becomes indurated, spreads, and is covered with a crust;[4] and when the crust is removed it bleeds a little. Subsequently it ulcerates, and an uneven open surface is formed, discharging thin bloody fluid and having a sinuous edge with a hard tuberated margin and an indurated base. The disease goes on spreading till the whole scrotum is destroyed; and the testicles are exposed and, occasionally, it is said, are involved in the destruction. Before this, however, the inguinal glands usually become indurated. Subsequently they soften and break, forming excavated cancerous ulcers, which spread till the patient is worn out by the discharge and pain. After death the disease is commonly found to be confined to the scrotum and groin, and not to have invaded the lumbar glands or the abdominal viscera.

It seems, then, to be quite a local affection, destroying life by the mere tendency to spread at the part primarily affected, and in the glands connected with it; and at first, and, it may be, for a long time, it often has hardly any of the qualities of malignancy. In one case that I remember, the surface of the body generally, and of the inner side of the thighs in particular, was covered with small soft cutaneous tubercles, evidently quite of simple character; and the cancerous ulceration of the scrotum had, apparently, originated in one of these. Moreover, the ulcerative tendency at the part varies a good deal. In some cases it commences before the mass has attained to the size of a shilling; in others the whole scrotum becomes converted into a tuberculated or warty mass, with scarcely any ulceration. I had one case of the latter kind in which the disease was of long standing, and too extensive for removal, and which terminated fatally. It has been met with in boyhood, but is usually seen about middle life; and it has appeared in persons long after they had discontinued the avocation of chimney-sweeping.

Treatment.—The only treatment is extirpation by caustic or the knife; the latter is much to be preferred. The operation is easily performed while the disease is limited to a part of the scrotum, and good hope of ultimate recovery attends it. Still in several cases the disease has returned, sometimes after a long interval, either in the scrotum or the groin. In such case the operation should be again performed; indeed, it may be repeated again and again, even though it be necessary to take away the whole scrotum and both the testicles, if there be fair prospect of removing all the disease. When the glands in the groin are only slightly enlarged they should be left alone; for they may subside or remain quiescent after the exciting cause of their disturbance is gone. If, however, the enlargement is more decided and accompanied with indu-

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head, involving also the nates. The whole mass was removed. Med. Times and Gaz., vol. xiv., p. 166.

[1] Auvert (Selecta Praxis Medico-Chirurgicæ, vol. ii., tab. cxi.) represents and describes an enormous urinary calculus, which began to form when the patient was ten years old, and ulcerated through the scrotum when he was seventy-one. A urinary calculus, weighing 8 ounces, in the Norwich collection, is said to have been removed from the scrotum. A shoemaker had, for twenty years, a stone in the scrotum, which he supported in a pad; at length it got to such a bulk, that, during exertion at stool, it ruptured the scrotum and escaped; it weighed 26 oz. Gräfe, "Ueber Scrotalsteine," in Gräfe und Walther's Journal, vol. iii., p. 399. Crosse, On Urinary Calculus, p. 32.

[2] A rare case of the growth of medullary cancer in the cellular tissue of the scrotum, involving and requiring the removal of both testes, occurring in the practice of Mr. Craven, of Hull; Med. Times and Gaz., vol. xix., p. 287. Mr. Curling mentions two cases of carcinoma of the scrotum, and one of melanosis.

[3] Dr. Warren has never seen it in the United States in chimney-sweepers, but has met with it in a few instances in persons not of that business; Surg. Obs. on Tumors, p. 329. In a few cases, in this country, it could not be attributed to the contact of soot. That it may be excited in other parts of the body by soot, is shown by Sir James Earle's case of the gardener who suffered from the disease in the forearm in consequence of his being in the habit of carrying a soot bag there.

[4] Or by a thick horn-like concretion, as represented by Mr. Ward; Cases of Diseases of the Prepuce and Scrotum, pl. x. and xi.

ration, they should be dissected out; and this may be done with very good result; for the disease of the glands is found to be of epithelial character, corresponding with that in the scrotum. In one case in which I dissected out the diseased inguinal glands at the same time that I removed the cancerous ulcer of the scrotum, the patient was well two years afterwards; in another the disease soon returned and proved fatal. This corresponds with the experience of other surgeons.

Affections of the Penis.

By far the larger proportion of these are, directly or indirectly, connected with and dependent upon gonorrhœa and syphilis; and they, as well as phimosis, paraphimosis, and inflammation of the corpora cavernosa, will be found treated of in the following essay.

Priapism. — Erections, too frequent, easily induced, and prolonged, are not an unfrequent attendant on debility, recovery from illness, and other causes which increase general irritability. Sometimes they are an indication of preternatural excitability of the organs induced by exhaustion, or of some irritation of or about the prostate, consequent, perhaps, on gonorrhœa. Priapism, or persistent erection, is a well-known attendant on certain diseases or injuries of the brain or spinal cord. In a few instances it has been caused by extravasation of blood into the cavernous body of the penis from injury during connection. [In children it is frequently caused by phimosis, particularly if it be complete and if there be an accumulation of smegma with a slight balanoposthitis.]

In a case of this kind, under Mr. Birkett,[1] where the attendant pain was very severe, some relief was afforded by incisions into the cells of the corpora cavernosa, which gave vent to dark, thick, blood-like fluid; Mr. Birkett does not recommend the procedure.

Gangrene.—The loose tissue of the organ renders it, like the scrotum, very liable to œdema and inflammation; and its comparative isolation renders it liable also to mortification, which has in several instances been known to occur in the depressed states of typhus. In some of these cases the patients were suffering from gonorrhœa at the commencement of the attack. The penis has also been known to mortify in paraplegia; and a case of spontaneous gangrene occurred, under the care of Mr. Partridge, in King's College Hospital.[1]

[This is exceedingly rare. Dr. Agnew reports one case occurring in an aged man and due to embolism of the dorsal artery. The patient died. I have seen one case in the wards of the Philadelphia Hospital in a man fifty-five years of age. There was general atheroma, and debility from intemperance and starvation. The process destroyed three-fourths of the organ, but the patient recovered.

Elephantiasis of the penis is a rare disease, a few instances of which have been recorded. Bryant mentions one in which the penis measured eight inches in length

[1] Lancet, February 16, 1867; other cases of a similar kind are there referred to. A case of persistent priapism in a married man, aged twenty-eight, of rather delicate health and nervous temperament, is related by Dr. J. R. Smith in the New Orleans Journal of Medicine, January, 1869. Bleeding, tartar emetic, morphia, belladonna, and cold applications were freely tried without effect. After a time, "the disease gradually and almost imperceptibly gave way." It does not appear that the bromide of potassium was used. It might be expected to afford relief in such a case; and was found to do so in a case recorded in the July number of the same journal by Dr. Hargis. Fifteen grains of the salt given every two hours produced speedy alleviation of the tension and distress.

For the effects of rupture of the bloodvessels and other injuries occurring during coition and erection, see a paper by Mr. Langston Parker in British Medical Journal, May 16, 1868.

[1] "The man was forty years old, single, and said to be temperate. A week before his admission he was at work as usual, when he become ill, languid, and feeble. He took to his bed, and ultimately became delirious. He was kept on low diet all this time. When received into King's College Hospital he looked like a man suffering from low fever. The penis was black and charred-looking nearly down to the scrotum; there was here a line of demarcation, and the urine spirted out at this point. The pulse was feeble and irregular. The penis ultimately dropped off. The parts healed, and the patient went out well." Med. Times and Gaz., vol. xx., p. 277.

The following case of partial strangulation of the penis from constriction is interesting in many respects: A boy was brought to the out-patient room of St. Bartholomew's Hospital with swelling of the penis and loss of sensation, and a fistulous passage communicating with the urethra. Mr. Wormald, discrediting the cause assigned (a blow), made a careful examination of the parts under chloroform, and discovered a small string tied round the base of the penis. It appeared that as the penis had swelled the ligature had slowly cut through the skin, nerves, and vessels of the penis; but, as in the operation of linear *écrasement*, the parts healed again as fast as they were cut, and had buried the ligature. Association Med. Journ., 1856, p. 9.

and six in circumference. Voillemier describes a case where the sheath of the penis and the prepuce were so enormously hypertrophied that the organ reached to the knees, and had a circumference of nineteen inches. Weir records one following urethral stricture and fistula; the penis was seven inches in length and ten in circumference. Of course, in such cases, amputation is the only remedy.]

Cancer of the penis is most commonly of the epithelial variety, occurs in advancing years, and corresponds in most points with epithelial cancer in other parts of the body. A case of scirrhous infiltration of the body of the penis has been recorded by Mr. Coote,[1] but such an affection is very rare.

It commences usually upon the glans, in the form of a firm warty elevation having a broad base, and slowly increases, for some time, without pain and, probably, without attracting attention. It is at first covered with a more or less thick cuticular crust. This becoming shed, or rubbed off at parts, the growth bleeds a little, and, before long, ulcerates, discharging thin fetid fluid mingled with blood. In this stage it is usually painful, and advice is, therefore, sought for it. If left alone it continues to spread, destroying the glans, opening the urethra, involving the prepuce, and, finally, extending to the glands of the groin, proves fatal by the irritation and discharges resulting from progressively spreading ulceration. It does not affect distant organs. It now and then begins upon the prepuce. Sometimes the prepuce is in a state of phimosis, perhaps from birth; or it may be ulcerated through, disclosing the growth beneath. Frequently, however, the prepuce is natural, and may be drawn backwards and forwards over the cancer.[2]

There is not commonly much difficulty in the diagnosis, partly because the cases do not come under our notice till the character of the disease is well marked. The patient has generally passed the middle period of life. The firmness, or hardness, of the growth, its ulcerating tendency, and the character of the discharge, together with the slow steady progress, leave little doubt of its nature. In the early stages it is not easy to make the distinction between a cancerous wart, and a common wart, or between a cancerous lump and and an indurated chancre which has not ulcerated, or has cicatrized. It is, then, well to give a cautious opinion, and to wait a short time, applying the means which are known to act upon the more simple malady; and it will generally turn out that those means are sufficient—that is to say, the doubtful cases generally prove not to be cancerous.

The only *treatment* is extirpation; and that is best effected with the knife. If the prepuce only be affected, circumcision should be performed.

Circumcision.—The plan which I always adopt is to make a circular incision with a bistoury through the skin on a level with, or a little behind, the corona glandis; then slit up the prepuce to this cut, and with scissors remove it by cutting through the lining membrane a little in front of the incision through the skin. The frænum should be left as long as it conveniently can be. The dorsal arteries, and one or two arteries beneath the urethral orifice, generally require ligature or torsion; and care should be taken to sponge the wound well, and tie or twist such others as bleed at all freely, so as to prevent after trouble. The edges of the skin and the lining membrane may then be brought together with a few points of suture, so that only a linear wound remains. This will sometimes heal in a few days, leaving only a linear scar. It is often not necessary to confine the patient to bed at all, though it is better to do so, or, at any rate, to enjoin rest. I do not apply any lint, plaster, or dressing. These adhere to the part, causing a good deal of distress, and keeping it foul. I simply direct it to be kept dry and clean. It may, after a few days, when suppuration takes place, be necessary to apply a poultice, or water-dressing. I once saw the operation performed with the écraseur. There was no bleeding; but an ulcerating wound remained, which was long in healing.[1]

Amputation.—When, as is far more commonly the case, the disease commences on the glans, it may still be possible to remove the affected part without destroying the whole of the glans, or interfering with the urethra. I have done this with good result. It seldom happens, however, that we see the case sufficiently early for this; and it is usually necessary to remove the whole of the glans and more or less of the corpora cavernosa.

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[1] Med.-Chir. Trans., vol. xxix. [1864].

[2] Mr. Hutchinson relates a case in which fungating epithelial growths spread along the mucous surface of the urethra in a young man; Path. Trans., vol. xiii., p. 167. I remember a similar disease in a little girl; I removed the growths, but they returned and proved fatal.

[1] I quite agree with those who recommend the entire removal of the prepuce in congenital phimosis, having seen the inconveniences resulting from less complete operations. The comparative immunity from syphilis in those who have been circumcised has been shown by Mr. Hutchinson; Med. Times and Gaz., December 1, 1855.

Before doing this, the prepuce, unless it admits of being retracted, should invariably be laid open, so as to expose the growth, and make quite sure of its real nature. The operation of amputation is usually effected by a single sweep of the knife, the skin having been previously drawn a little forward, to prevent there being a superabundance of it afterwards. A good deal of bleeding ensues, the blood pouring out from the whole divided surface of the corpora cavernosa, as well as from the dorsal arteries. The latter should be tied first; then the larger vessels upon the rest of the stump; and the numerous smaller vessels will close spontaneously after a few minutes. The dread of the bleeding has induced the occasional resort to the écraseur. That, however, is not a sure preventive; for sharp hemorrhage has followed a few hours after the operation, and it leaves a more sloughy and troublesome wound than the knife.

The stump will granulate and heal spontaneously, the skin closing over the face of it, and becoming puckered to a narrow circle surrounding the urethral orifice. The real, indeed usually the only, difficulty in the operation and subsequent management is caused by the tendency of this circle to contract, more and more, so as to narrow the orifice and interfere with the passage of urine. In a case that I remember, the stricture thus caused led to so much irritation and inflammation of the bladder that the patient, a strong hearty man at the time of the operation, was fairly worn out and died. It is true that in other cases this difficulty has not occurred, although no means have been taken to prevent it. Nevertheless, the liability must always be borne in mind. It may be sufficient to keep a catheter, or other instrument, in the passage. Some patients cannot bear that. To avoid its necessity the following slight addition to the operation has been recommended by Mr. Teale.[1] "After the operation of amputation has been performed in the ordinary way, a director is introduced into the urethra, and by the aid of a bistoury, the urethra and the skin covering it are slit up to the extent of about two-thirds of an inch. A single suture is then placed on each side of the slit, uniting the mucous membrane to the skin. Perfect patency is thus given to the orifice, which is of a long oval form; and, after cicatrization is complete, there remains a free opening into the urinary canal, and no mechanical aid is required. The same procedure may be adopted when contraction has occurred during the cicatrization after amputation, and much trouble and pain will thus be spared."

[Mr. McGann describes as follows (British Med. Jour., Jan. 29, 1881), an amputation of the penis which he performed for the removal of cancer: the patient was placed on the table in the lithotomy position, and, chloroform having been given, an assistant, holding the scrotum in both hands, drew it forwards, keeping the raphé of the scrotum and perineum in the same line. An incision of about two and a half or three inches in length was made in the median line, with its centre over the bulb; the corpus spongiosum having been completely exposed, the scrotum was allowed to drop and was drawn slightly backwards, and the penis was removed by a single sweep of the knife close under the pubis. An indurated portion of the scrotum at the right side was also removed. The scrotum having been again drawn forwards as before, the cut surface of the corpus cavernosum presented itself through the posterior incision; the bleeding vessels were then tied with fine silk, and the corpus spongiosum dissected from the corpus cavernosum, and turned down into the perineum. All bleeding having ceased, the margins of the front incision were brought together by means of sutures and strapping, and the incision behind was also treated in like manner, and, finally, the corpus spongiosum was slit with scissors to the extent of half an inch on its lower or posterior aspect, and the margins secured to the perineal skin on either side by two points of suture. This latter is better practice than leaving it simply protruding and undivided, as, in the latter case, when it retracts, as it always does, the introduction of a catheter into the bladder, should such a procedure be necessary, is more difficult.]

I have lately performed the operation in such a manner as to leave the urethral orifice projecting from the end of the stump, and have been well satisfied with the result. I make a circular incision through the skin behind the part to be removed, and reflect the skin for about half an inch, then cut through the spongy body on the level of the first incision, dissect it from the corpus cavernosum to the same extent as the skin, and cut through the corpus cavernosum at this point—that is, half an inch behind the line at which the skin and the corpus spongiosum were divided. Finally, the edges of the reflected skin are united over the stump of the corpus cavernosum by a point or two of suture, the spongy body with its urethral orifice being left projecting a quarter of an inch or more beyond the surface of the wound. It remains slightly projecting, and with a freely open aperture, after the wound has healed.

[1] Medical Times and Gazette, vol. xix., p. 354.

In cases in which it has been necessary to amputate near the scrotum—a situation in which there is especial tendency to contraction of the urethral orifice—I have, after making a straight cut through the penis in the ordinary manner, carried an incision through the raphé of the scrotum into the perineum, exposing the corpus spongiosum. I then dissected that body from the corpus cavernosum as far as the crura penis, turned it down into the perineum, and left it hanging out there half an inch beyond the level of the skin. The cut edges of the scrotum were united by a few points of suture in front of the urethral orifice. The patients recovered quickly, and experienced no difficulty in passing water through the perineal aperture.

When the disease has been completely removed, there is fair prospect of complete cure. I have watched patients remaining for several years in good health. Too many cases, however, have proved the tendency of the disease to manifest itself in the groin after the removal of the penis, if it had not done so before. The affected glands should be removed, if that can be done with safety; the remarks made with regard to the conditions ensuing upon cancer of the scrotum applying to this disease.

GONORRHŒA.

By Henry Lee, Esq.

Revised by J. William White, M.D.

Of the diseases of the generative organs which, for the most part, take their origin from impure sexual congress, pathology and clinical observation have alike established the existence of three groups, separate and distinct from one another.

I. Gonorrhœa—an inflammation of the mucous membrane of some part of the generative organs, producing muco-purulent discharges. In the male this is frequently attended with an inflammation of the testicle, and in some cases is followed by symptoms referable to the joints and eye.

II. The soft, suppurating, contagious ulcer of the genitals, which differs from the next in the most important characteristic, that it is localized in its sphere of morbid influence, and does not induce general or constitutional infection.

III. That disease which, commencing as a localized affection of some kind, generates those other and more general morbid symptoms denominated constitutional syphilis.

These all agree in the respect that they are contagious, and, however much opinions may differ as to the former, the two last have for their cause a specific virus.

[If by this somewhat doubtful sentence it be meant that syphilis and the chancroid depend upon a single virus for their causation, or that each is caused by a specific virus of its own, it cannot be said in either case that the assertion is universally accepted. On the contrary, a large number of careful observers are of the opinion that the soft sore is the result of pus-contagion and is in no sense a truly specific disease. A smaller but increasing number of syphilographers discard as unnecessary and unphilosophical the theory of an unseen and unisolated virus, and attribute all the symptoms of syphilis to the absorption of a degraded immature cell resembling a white blood- or lymph-cell, which is thought to be the essential element of contagion, and the existence of which is said to be demonstrable in all stages of syphilis. Of course the discussion of these theories would pass beyond the limit of the present article.]

The most frequent disease arising from sexual intercourse is, without doubt, gonorrhœa. This name, although somewhat incongruous—for the prominent symptom of the disease is not a flow of semen, as the derivation of the term indicates, but a muco-purulent or purulent secretion and discharge from the diseased surface—has been so long in use that its abolition would be attended with difficulty.

By some writers the affection is termed "blennorrhagia." By the vulgar it is termed the "clap" in England, and "chaude-pisse" in France.

There is every reason for believing that this disease has been known from very remote times. The sanitary measures inculcated by the Hebrew lawgiver in the

15th chapter of Leviticus have, in all probability, reference to this disease. It appears likewise to have prevailed among the Greeks and Romans.

[The sudden and extraordinary spread of syphilis which occurred in Europe about 1494 may have been due, as has been suggested, to a fresh importation of the disease from this country through the medium of the sailors who had arrived in Europe with Columbus a short time previous. The researches of Dr. Jones, of New Orleans, upon aboriginal skeletons seem to show that the disease had been very prevalent and was of great antiquity in America.

Or the extension of the disease may have arisen, as Cazenave argues, from the coincident spread of some other epidemic which lowered the general standard of health, favored contagion, and caused cases which ordinarily would have been trifling to assume virulent, phagedenic or rapidly progressive and even fatal forms.]

Very shortly after the irruption of syphilis into Europe, towards the close of the fifteenth century, a belief in the unity of species and cause of all the contagious diseases of the genitals became widely prevalent. Observers, perceiving that these diseases commonly originated from one source — sexual congress — referred them all to one and the same cause, embracing them alike in the common term of "venereal." The confusion and perplexity thus introduced continued to our own day. To the genius and sagacity of Ricord it is undoubtedly due that these almost insuperable difficulties to the right appreciation and study of these diseases have been removed.

Gonorrhœa is an affection of a totally different character from the primary syphilitic ulcer—whether we have regard to its history, pathology, symptoms, terminations and consequences, or its treatment.

Acknowledging all this, as is generally done in these days, there remain a number of well-observed facts which would seem, nevertheless, to militate against it. The writer alludes to those cases in which symptoms of secondary syphilis follow discharges from the urethra, apparently identical with those produced by gonorrhœal inflammation. The explanation usually given is, that when urethral discharges have preceded a syphilitic infection, such discharge has been symptomatic of a chancre within the urethra—"chancre larvé" of Ricord. In support of this theory it is alleged—1st, that intra-urethral chancres have been demonstrated in some such cases, and hence probably existed in the remainder; 2dly. that the inoculation of urethral discharge has been followed, occasionally, by the same phenomena as succeed the inoculation of fluids from a chancre; 3dly, that acquired constitutional syphilis, whenever its course has been observed, has invariably been preceded by some primary lesion of the nature of chancre, and hence that it is in the highest degree probable that the same process may ensue within the urethra, where it is concealed from our sight, as obtains in other parts patent to our observation. It is important to remember that those who deem the foregoing theory unsatisfactory, when applied to *all* cases in which constitutional symptoms have succeeded urethral discharge clinically identical with gonorrhœa, do not at all deny the existence of urethral chancre. They contend that all we can say in these exceptional cases amounts to this—that the existence of chancre has been presumed but not demonstrated; and that from time to time cases of secondary syphilis ensue after discharges from the urethra, in which it has been quite impossible to distinguish the urethral disease from gonorrhœa, and wherein all the evidence at command was strongly against the existence of a chancre concealed within the urethra. Many deny altogether the existence of a chancre deeply seated in the urethra. Vidal, for example, does not admit such, beyond the navicular fossa. The transmission of a virus to a distant part of a canal like the urethra is confessedly difficult of explanation, and it has not been demonstrated to the satisfaction of many pathologists that the two morbid specimens of deep-seated ulceration of the urethra, upon which M. Ricord relies to establish his theory of the chancre larvé, were in reality chancres at all.

[Certainly it is one of the rarest occurrences to find a chancre situated so deeply that it cannot be brought into view by widely separating the lips of the meatus. In the vast majority of cases, if not in all, the induration and the erosion—actual ulceration is not common—occupy the anterior extremity of the urethra, and can be easily felt and seen.]

The importance of the subject renders it essential that we should endeavor to obtain clear views upon it.

From the time of Swediaur to the present day there has been a well-grounded belief in the existence of a syphilitic blennorrhagia. Hunter, who believed in the identity of gonorrhœa and syphilis, cites the results of his inoculation of pus from gonorrhœa, which inoculation produced sores having all the characters of chancre, and were followed by symptoms of general infection. The case is related Vol. I., p. 205.

These facts can neither be mistaken nor ignored. Their explanation is well worthy

of careful consideration. Two views may be assumed, either of which will yield a probable explanation: first, that the urethral pus was obtained from a concealed syphilitic sore (chancre larvé), alone and unmixed, or mingled with the products of a coexisting gonorrhœa. The second view rests upon the assumption, that not only the fluid products of secondary lesions, but that the blood and fluid excretion from a person constitutionally syphilitic, may produce that disease in a sound person by inoculation.[1]

It ought not to be forgotten also that the mucous membranes are the frequent seats of the earliest constitutional manifestations, and that a muco-purulent discharge from the urethral membrane is an occasional symptom of secondary syphilitic infection.[2]

Hunter conceived that the pus from a chancre or blennorrhagia applied to a secreting surface (mucous membrane), would invariably produce gonorrhœa; while applied to a non-secreting one, such as the integument, it would equally always develop a chancre.

It is true that this pathology cannot hold its place in the presence of later observations and experience; but there are not wanting a few, though extremely rare, facts corroborative of the truth of Hunter's view of a "physiological absorption," *i.e.*, the absorption of virus into the blood, without any lesion of the surface to which it is applied.

The bubon d'emblée is an example of this. [The bubon d'emblée, as alluded to here, is not now believed to exist. A gland in the groin may suppurate spontaneously, as may a cervical gland, or may become inflamed as a result of irritation from a herpetic ulcer, or of infection from a chancroidal sore, either of which may have disappeared long before the glandular symptoms become noticeable, but the theory that such a bubo results from the absorption into the blood through an unbroken surface of some specific virus, and that it is the first evidence of a constitutional contamination, is not at present tenable.] When we speak of primary infecting sores, we must remember that these do not all alike possess the same objective signs. A primary syphilitic lesion may possess scarcely any induration: and the same may be said of its ulceration or erosion, the amount of which may be barely appreciable. We are ignorant how far the physiological properties of the deeper tissues of the urethra may affect the development in them of specific disease, because of our inability to watch the progress of the disease in the parts.

It has been proved that a purulent fluid, furnished by the female generative organs, can excite a gonorrhœa. Now if such fluid be obtained from a woman constitutionally syphilitic — and uterine discharges are very frequently indeed present in such—there is no reason against its being the vehicle of a syphilitic virus. [There is no evidence, either clinical or experimental, that a uterine discharge, such as leucorrhœa, occurring in a syphilitic woman but not derived from mucous patches or other early secondary lesions, is capable of transmitting syphilis. It is an accepted axiom that syphilis *always* begins by the appearance of some form of its characteristic initial lesion at the point where the virus — or degenerated corpuscle — gained access to the blood or lymphatic system.] The primary syphilitic disease will then run its course in the urethra as a part and parcel of the gonorrhœal inflammation, and the limits of any induration which usually accompanies primary syphilitic disease will be lost in the swollen state of the tissues. [A urethral chancre may by the irritation of its secretion give rise to a general urethritis, and become merged in the general symptoms of the latter condition. This, however, is a very infrequent occurrence. I have seen one such case.]

Discharges from the urethra and mucous passages of the generative organs may arise from the application of various purulent and irritating secretions to the mucous membrane, or be symptomatic of some constitutional or other disease.

The causes of blenorrhagia will fall under one or other of the following heads:

1. The application of a gonorrhœal discharge to a part of the sexual organs—direct contagion.

2. Certain irritating substances applied to the mucous membranes, *e. g.*, menstrual fluid, leucorrhœal discharges, etc.; and other irritants, rather interesting to the pathologist than of any practical value to the surgeon, such as the injection of a solution of ammonia, as in the experiment of Swediaur upon himself.

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[1] See the writer's work on Practical Pathology, vol. ii., 1870; also Viennois, in Archives gén. de Méd., June, 1860.

[2] Vide Bassereau, Affections syphilitiques de la Peau, p. 356.

Rollet seems to have arrived at the conclusion that, although the blood of syphilized persons is inoculable, their pus is not. He says that if pus be taken from the urethra of a syphilitic person suffering from gonorrhœa, but whose genital organs are free from syphilitic eruption, and if this pus be inserted in the mucous membrane of another, free from any syphilitic taint—an ordinary gonorrhœa only succeeds; if blood, however, be taken and mixed with the pus, then both gonorrhœa and syphilis may follow.

3. Urethral discharge may arise from constitutional and other causes, irrespective of any contagious influence; as in gouty or rheumatic subjects, and after the use of certain drugs, etc.

Complaints closely resembling gonorrhœa sometimes appear in persons the subjects of stricture or irritable urethra, after sexual intercourse, a debauch, or other excitement.

Occasionally, though very rarely indeed, venereal excitement alone may induce a blennorrhagia of the urethra.

[I have seen one case of gonorrhœa which seemed to me to be due beyond question to the local effect of continued cold. It occurred in a sailor who to my certain knowledge had had no opportunity of connection for several weeks. On reaching port he became intoxicated before leaving the pier on which he landed, and sat for some hours with his buttocks and perineum in contact with cold, damp stones. The following morning a urethritis developed and ran its usual course accompanied by chordee and intense vesical irritation. He had had one previous attack, but many years had elapsed, and there had been no sign of a gleety or other urethral discharge.

As the possibility of such an occurrence is questioned, even by those who believe in the non-specificity of gonorrhœa, the case seems worthy of mention.]

As most people are aware, gonorrhœa is very frequently the result of direct contagion, from intercourse with a person similarly affected. It is needless, therefore to enlarge upon this; but it is of the utmost importance, in a medico-legal sense, to remember that the symptoms of gonorrhœa may be produced by various agents, other than the application of gonorrhœal pus.

It is absolutely certain that gonorrhœa in the male may proceed from intercourse with a woman in whom no morbid changes in the genital organs can be detected upon minute examination with the speculum. Ricord's remarks upon this subject deserve attention. He says:—

"If we investigate with the greatest care the exciting causes of gonorrhœa—and I am now speaking of characteristic cases of the disease—we cannot help admitting that a gonorrhœal virus is absent in the majority of cases. Nothing is more common than to find women who have occasioned gonorrhœa unsurpassed in intensity and persistency, and attended by the most serious complications, and who are yet only affected with uterine catarrh, which is sometimes hardly purulent. In many cases, intercourse during the menstrual period appears to be the only cause of the disease; while, in a large number, we can discover nothing, unless, perhaps errors in diet, fatigue, excessive sexual congress, the use of certain drinks, as beer, or of certain articles of food, as asparagus. Hence the frequent belief of patients, which is very often correct, that they have contracted their gonorrhœa from a perfectly sound woman.

"I am most assuredly familiar with all the sources of error in such investigations, and I will presume to say that no one is more guarded than I am against the various forms of deceit which are strewn in the path of the observer; yet I confidently maintain the following proposition: *Gonorrhœa often arises from intercourse with women who themselves have not the disease.* Any one who studies gonorrhœa without preconceived notions, is forced to admit that it often originates from the same causes that give rise to inflammation of other mucous membranes."[1]

Diday says emphatically, "*that from the very fact of a woman having a discharge, no matter what its origin, she is liable to give a discharge to a man.*"

Fournier, as the result of his investigations relative to the classes of women from whom gonorrhœa is derived, conceives that gonorrhœa is much less frequently contracted from contagion than from excessive coitus, repeated or prolonged sexual congress, or peculiar excitement during the act.

[*Women from whom Gonorrhœa was derived.*

Registered prostitutes . . .	12
Unregistered prostitutes . .	44
Kept women	138
Shop girls	126
Domestics	41
Married women	26
	387

It will be seen from these figures that the women who are unquestionably most exposed to contagion, the prostitutes, form a very small percentage of those giving rise to the disease, whereas those women whose experience had not yet taught them the necessity of cleanliness and personal care, and who were consequently apt to be subjects of uterine and vaginal discharges, transmitted it with great frequency.

Moreover the records of the Paris hospitals show that three-fifths of all the men admitted for venereal troubles were affected with gonorrhœa, while the percentage of such cases among the females was exceedingly small; as compared with uterine catarrh gonorrhœa was much more infrequent, the proportion being one to thirteen.]

The opinions of many English surgeons,

[1] Lettres sur la Syphilis, 2d edit., p. 29.

particularly those of Mr. Skey and Sir Henry Thompson, are to a similar effect, that a gonorrhœa is the product of other causes than a specific poison. Those who oppose this view seem to do so upon the grounds that a gonorrhœa is confessedly a highly contagious disease, and that cases of gonorrhœa so caused differ, in the degree and intensity of the symptoms, from a urethritis excited by other causes.

The truth of the latter statement is somewhat questionable; but, however this may be, it will not affect the question.

[Its truth must seem more than questionable to surgeons who have witnessed the violent and persistent cases of gonorrhœa—or rather of urethritis—which so frequently result from sexual or alcoholic excesses in patients suffering with old gleety discharges. Such cases and those caused by local irritants, the use of caustics upon the urethral mucous membrane, the careless introduction of instruments, etc., are in no wise distinguishable from cases produced by pus-contagion, and aid strongly in establishing the non-specific character of gonorrhœa.]

The fact of the disease being so commonly caused by impure sexual intercourse is proof of the presence and action of a poison, but only of such a one as is capable of being produced by simple inflammation. A little consideration will serve to remove the obscurity about this subject.

Opinions have been much modified of late concerning the "specificity" of inflammations. Van Roosbröck's experiments go to prove that an ophthalmia may result from the inoculation of any pus, and that the true morbific property of that fluid depends upon the cells; for when it has been deprived of such by filtration, the remaining liquor appeared innocuous. Mr. Simon, in his essay upon INFLAMMATION (Vol. I. p. 93), remarks: "There is ample room to question the popular impression that only specific inflammations are communicable; much reason for suspecting it, on the contrary, to be a generic and essential property of inflammation, that its actions (or some of them) are always in their kind, to some extent, contagious." Simon quotes from Dr. Guillié's and Sir Patrick M'Gregor's experience upon the occasional contagious properties of infantile and common catarrhal ophthalmia, and cites Dr. Piringer's experiments to the effect that he had succeeded eighty-seven times in exciting conjunctival inflammation by the contact of an inflammatory product (pus), taken from sources the most various.

[It is rarely, if ever the case, that the various forms of conjunctivitis, common purulent ophthalmia, gonorrhœal and Egyptian ophthalmia, and ophthalmia neonatorum, are separated from one another by any broad clinical or pathological characteristics.]

The experience obtained at some of the London Ophthalmic Institutions is corroborative of the truth of the statement, first made by Van Roosbröck, that as the inflammation, which has produced the pus used for inoculation, has been active and acute, so will the artificial inflammation excited by it be severe in its character.

In this way gonorrhœal pus, applied to the conjunctiva, exhibits far more active properties than pus from most other sources.

It follows from this that the observations of practical surgeons are borne out by modern pathology, and that a gonorrhœal discharge may be the result of other than specific pus.

[There is no analogy between the course of a gonorrhœa, and that of the undoubtedly specific diseases. It has no incubation; it may be artificially produced; it confers no immunity from a second attack; it may, after apparent extinction, become as virulent and active as ever; it is accompanied by no special pathological changes.]

There is yet another mode of explaining some of those cases in which an individual has contracted a venereal affection from one in whom no disease can be discovered. The doctrine of "mediate contagion," as it is called, so long regarded as highly probable, has recently received experimental proof at the hands of M. Cullerier. Although the experiments were made with a syphilitic virus, their bearing upon the subject of gonorrhœa is evident.

"Louise Vaudet, aged sixteen, entered the Hospital of Lourcine, ward of St. Mary, No. 9, on October 10, 1848. She bore on each thigh an ulceration with a gray floor and abrupt edges. The disease dated a month. On November 25, after having ascertained beyond a doubt that the mucous membrane of the vulva and vagina was not ulcerated in any part, and that the discharge from these parts was not inoculable, I collected upon a spatula the pus produced by one of the inguinal chancres, and laid it in sufficiently large quantities in the vagina. I made the patient walk up and down during thirty-five minutes, taking care to watch her, so that she might not place her hand on the vulva. After this lapse of time, I placed upon a lancet a certain quantity of the vaginal secretion, and I inoculated with it one of the patient's thighs. I then washed with water the vagina and vulva; I carefully wiped the parts, and then washed them again with a strong solution of alum. Forty-eight hours after, the puncture of inoculation had produced a characteristic pustule. I left it till next day, so that the experiment might be more certain, and then destroyed it with Vi-

enna caustic. Nothing whatsoever appeared in the vagina; the inflammation was not increased; and after two months the patient quitted the hospital perfectly cured of the vaginitis, as well as of the inguinal ulcerations.

The second experiment was made upon Celestine X——, aged twenty-four, who entered Lourcine, ward of St. Louis, No. 7, on November 28, 1848. She bore on the left thigh an ulcerated bubo of two months' date, and which, according to her, had succeeded a pimple, seated on the internal surface of one of the labia majora, which had only lasted for a few days. At the time of her admission into the hospital no trace could be discovered of this pimple. The vulva, the vagina, the neck of the uterus, and the anus were all in a perfectly normal state. The aspect of the ulceration on the thighs made me suppose that it was specific. On the day following, the 29th, the pus proceeding from the bubo was placed upon a spatula, and laid in the vagina, care being taken to carry it as high as possible. The patient was then made to walk about for an hour, without knowing that she was the object of an experiment. She was taken back to bed; and I then collected as much as I could of the vaginal mucus, remarking to some pupils and young colleagues who surrounded me, that none of the pus introduced into the vagina could be seen, and that what I had on my lancet was entirely similar to the normal mucus. I inoculated one of the thighs, using the same precautions in washing as I did in the former case. After two days, the characteristic pustule rose, and I only destroyed it after forty-eight hours. The vulva, vagina, and the neck of the uterus were carefully observed during several days, but nothing appeared; the disease restricted itself to the thigh. I must not neglect to say, that although there was no sign of disease in the interior of the organs of generation, yet I made on the same day an inoculation with the mucus with which they were covered, and obtained a negative result."[1]

From these observations it results that a female may be the vehicle of disease without being herself affected; and that a virulent pus may be retained in contact with the vaginal tissues for a certain time without producing that diseased action which it is capable of inducing elsewhere.

[These facts may be illustrated and possibly rendered more comprehensible by a case which recently came under my notice. Two men had connection with the same woman, a prostitute, on the same evening, with an interval of about two hours and a-half. The first one was suffering with a urethral discharge, chronic, but decidedly purulent. The second, a young married man, developed an acute urethritis in about forty-eight hours. The woman revealed no evidence of disease upon a careful examination, and, so far as I have been able to learn, has not been accused either before or since of infecting any one else, although her opportunities have been numerous. Such cases are not uncommon.

At intervals of a few years, the doctrine of the dependence of gonorrhœa upon the presence and growth in the urethra of vegetable organisms,—bacteria and micrococci, is revived and discussed. Neisser, Salisbury, Bokai, and lately Dr. Cheyne, Assistant-Surgeon to King's College Hospital, have claimed to base their diagnosis and treatment of the disease upon the existence of these organisms. As their observations have never been confirmed except as to the discovery of micrococci, such as are found in pus under all circumstances, and whencesoever derived, and as the antiseptic plan of treatment is usually a conspicuous failure, it will not be necessary further to allude to these theories.]

Seat and progress of the disease.—Gonorrhœa or blennorrhagia is an inflammation, ordinarily acute, of the mucous membrane of the urethra or some other parts of the genito-urinary tract, and accompanied by a muco-purulent or purulent discharge. In the male it comprehends varieties according as it is located in the urethra, upon the prepuce, or glans penis. It may be confined to one of these parts only, or occupy more than one, or all, at the same time.

Gonorrhœa of the nose, mouth, anus, etc., have been described; but the existence of these is open to question, and they are relatively of such rare occurrence that we may, practically, altogether discard them.

Differences of opinion are entertained as to the exact seat and extent of the disease in the male urethra; some conceiving that it commences exclusively at the fossa navicularis, others at a part more posterior; while Astruc thought that it had its special seat in the various glands and the reservoirs. No doubt some differences will be found to exist in different cases, alike as to the extent of the membrane involved and the acuteness of the inflammatory process.

The ordinary seat, however, of the disease is in the more superficial layers of the mucous membrane, and the inflammation affects the orifices of the follicles and lacunæ in the urethra. It commences, for the most part, at the fossa navicularis and the neighboring mucous membrane, and, as it advances, spreads backwards, by contiguity and continuity of tissue, to the posterior extremity.

[Endoscopic examinations have shown that in acute urethritis of an active type

[1] Condensed from Dr. Cullerier's work, Des Affections blennorrhagiques, 1861.

the mucous membrane is greatly puffed out, decidedly reddened, and shows erosions here and there. The lacunæ are usually invisible, or their depth is reduced to a minimum. Other varieties of little clinical importance are described—a *membranous* urethritis with inflammation of the dorsal lymphatics of the penis; a *granular* urethritis with numerous punctiform elevations of the mucous membrane; a *suppurative* urethritis with the formation of abscesses in the submucous connective tissue; an *ulcerative* urethritis, noticed in persons predisposed to herpes, etc. etc. These differences are interesting pathologically, but in practice only excite attention through the production of symptoms which constitute indications for treatment.]

The points at which the inflammation remains most commonly fixed, and in which it is manifested with the greatest intensity, are the fossa navicularis and the vicinity of the bulb. The appearances noticed by Hunter, Sir Astley Cooper, and Ricord, in their dissections, were inflammation of the urethra, without breach of surface; and these appearances were most marked within two inches of the meatus and at the bulb. Although this is an adequate expression of the seat and extent of the inflammation in most cases, with some it is far otherwise.

Gonorrhœal inflammation does not ordinarily affect the whole of the urethral mucous surface, but in some cases, as Wallace remarks, it may be diffused over a wide surface, and "may involve at the same time the whole of the urethra, the bladder, the testicles, the glans, and prepuce, in the male; and in the female, the nymphæ, clitoris, labia, vagina, etc.; and thus commencing at the preputial end of the penis, in the fossa navicularis, it not unfrequently creeps slowly on to the posterior parts of the urethra, to the bladder, or to the testicles, while it decreases or ceases entirely in the parts first affected."[1] It may be confined to the mucous membrane only, or extend to the tissues beneath. Sometimes it would appear that the inflammation is localized to some part of the canal, inducing thickening and effusion into the submucous tissues, and maintaining for a long period a scanty purulent or gleety discharge.

In the chronic stages, the mucous membrane may become granulated like the palpebral portion of the conjunctiva in chronic ophthalmia.

Gonorrhœa in the Male.

Men are much more liable to contract this disease than women.

The first attack is generally the most severe, and a kind of tolerance of the disease is commonly found to follow repeated attacks. The symptoms usually appear from the second to the fifth day after exposure; sometimes, though rarely, at later dates.

The progress of the disease may be conveniently divided into four stages.

I. The symptoms are at first very slight, consisting of an itching or tickling sensation of the meatus; this is found rather more florid than normal, and the lips of the canal are glued together by a small quantity of viscid colorless secretion. This moisture augments in amount, but continues scanty, and passes from the clear watery appearance to one of opalinity. Slight puffiness of the lips of the meatus appears at this time. There is no ardor urinæ at this stage, but only such modifications of sensation as amount to a trifling smarting.

[Patients who have suffered frequently from gonorrhœa are often able to recognize the onset of a new attack by a symptom which precedes even these, and which consists, so to speak, in an obtrusive consciousness of the possession of a penis, an unavoidable direction of the thoughts toward that organ, in which, however, no abnormal sensation or appearance are as yet present.

My attention was first called to this fact by the late Dr. Maury, who even went so far as to consider it an indication for treatment, and I have repeatedly verified its occurrence.]

This stage may last from a few hours to two or three days.

The inflammation, such as it is, is both very incipient in degree and limited to the neighborhood of the meatus and fossa navicularis.

This is the premonitory stage.

II. The symptoms gradually increase in intensity until a highly inflammatory condition is reached. The mucous membrane of the glans is swollen and inflamed, and the entrance of the meatus appears also swollen and florid. Sometimes there is œdema of the prepuce, slight in degree, or sufficient to cause phimosis. The discharge augments rapidly in amount, loses its opaline character of muco-pus, and becomes a thick creamy pus with a tinge of green. The penis and course of the urethra feel tender and swollen to the touch. The slight smarting increases to a severe degree of scalding in passing the urine. The patient voids it with difficulty in a smaller or forked stream; oftentimes it makes its exit in jerks, alternating with the spasms of the muscles lining the urethra. When the mucous membrane about the bulb is engaged, the patient suffers from pain and weight in the pe-

[1] Wallace, Treatise on the Venereal Disease, pp. 237, 238.

rineum, which are augmented in voiding his urine.

At night, when the sufferer becomes warm in bed, he is liable to attacks of involuntary erection and chordee. This latter term is applied to that arched or bent position which the penis assumes in erection. The explanation generally given of this phenomenon is this: the urethra, the chief seat of the inflammation, runs along the under surface of the penis. The lymph, which is apt to be effused around this canal, renders it less extensible than that portion of the organ composed of the corpora cavernosa. Hence, in a state of erection, the corpus spongiosum surrounding the urethra, not yielding to the distension, acts like the string of a bow, and chordee is produced. [This explanation is undoubtedly the correct one. There is an analogous condition, a chronic, circumscribed inflammation of the corpora cavernosa, first described by Van Buren and Keyes, but not so rare as those authors seem to consider it. In this condition erections are equally painful, but the bending is in the reverse direction, *i. e.*, the concavity of the curve is upward, or, if only one cavernous body is affected, the bend is lateral and toward the side involved.] Mr. Milton conceives the mechanism of chordee to be due to spasm of the muscular fibres, described by Mr. Hancock and Professor Kölliker as surrounding the whole course of the urethra.

[The muscular fibres to which Mr. Milton refers are the longitudinal layers said to partially encircle the urethra. These, however, are very scanty, are sometimes almost entirely absent, and have no normal functional activity. It is hardly conceivable that even under persistent irritation they should exert sufficient force to produce the severe and often long-continued bending of the penis found in chordee. Then, too, the characteristic pain in erection is not infrequently experienced without the least curving of the organ.]

Abscesses occasionally form in the areolar tissue surrounding the urethra, either anteriorly to the scrotum or in the perineum. [The points most frequently occupied by these abscesses are the fossa navicularis and the bulb. In the latter situation they often constitute a serious complication, and should be opened early and freely.] It is not uncommon, also, for one of the lacunæ of the urethra to inflame, suppurate, and form a small abscess (lacunar abscess).

This stage lasts from one to three weeks; the continuance or not of inflammatory phenomena depending very much upon the constitution of the individual, his mode of life, and the number of previous attacks.

The disease, having ascended by a rapid course to a period of maximum severity, gradually subsides and loses its more acute symptoms.

III. This is the stage of decline; the symptoms and discharge having run through the same phases, in an inverse order which they did at the outset of the attack. There is a marked diminution or entire cessation of scalding in passing water; the penis is no longer hot, painful, or tender; the involuntary erections and chordee being absent altogether, or, more commonly, of less frequent occurrence. The discharge slowly diminishes in amount, partaking less and less of the characters of pure pus, and, before disappearing, becoming almost entirely mucous.

This stage is both longer and more uncertain than the preceding ones. It being one of discharge without inflammation or marked complications, it may be readily conceived that either are easily excited and prone to recur.

IV. The last stage does not occur in all cases. It is known by the name of blennorrhœa or gleet, and comprehends a slight but chronic discharge from the urethra, unattended by symptoms of inflammation.

It is impossible accurately to define a line of separation between this and the previous stage, which it generally follows without interval.

A very scanty discharge occurs every morning upon rising from bed, and the lips of the urethra appear gummed together. By pressure, perhaps a small amount of matter can be expelled. The characters of this discharge will vary according as it is the product of a chronic inflammation of some part of the mucous membrane alone, or mixed with the various glandular secretions. Sometimes it is a glairy mucus; sometimes a concreted pus, or a prostatic secretion, or a combination of these. This state is liable to be increased, and attended with irritability of the urethra or bladder, under the aggravation of some such exciting causes as coitus, a debauch, etc.

[It is very desirable that the surgeon should distinguish carefully the yellowish-white discharge seen at intervals during the day, accompanied by a slightly reddened meatus and traces of ardor urinæ and chordee, due to chronic gonorrhœa, from the milk-and-watery discharge of gleet, seen only in the mornings, almost or quite painless, often associated with a little dribbling at the end of urination, and generally due to sub-mucous thickening or actual coarctation of the urethra; and also from the perfectly clear and

transparent discharge, without subjective symptoms, which sometimes follows a gonorrhœa, and is simply an excess of the normal urethral moisture, due to a catarrhal condition of the mucous follicles.

The first requires for its cure the continued use of appropriate injections; the second will not permanently disappear unless the thickening be absorbed or the contraction dilated by the proper use of instruments; the third requires no local treatment, and will often subside under a tonic regimen, or spontaneously.]

There are no further symptoms; but the disease is apt to prey upon the patient's mind, and so derange his health and assimilative powers. Haunted by his fears and morbid suggestions as to impotence, he may be deemed fortunate if he escapes the clutches of some advertising charlatan.

Gleet is often the result of an imperfectly-cured gonorrhœa; sometimes it is due to a localized chronic urethritis of the bulb, organic changes within the urethral canal, such as stricture, or mucous vegetations, or it is maintained by an implication of some one or other of the glands in a blennorrhœal inflammation.

From whatever source it arises, it is liable to be kept up by certain bodily conditions, congenital or acquired, such as a general debility or delicacy of constitution; a strumous, rheumatic, or gouty diathesis; or a lymphatic temperament.

Hunter, in his work on The Venereal Disease, speaks of gleet as perfectly innocent with respect to infection; and adds that in the relapses, which so frequently occur, the virus, in his opinion, does not return. Nothing can be more dangerous than the practice which would follow from such a doctrine. Even if the purely gleety discharge were proved to be innocuous, we know that it is liable to a puriform change upon many and apparently slight exciting causes, and then it would, without doubt, be capable of inducing disease in another. So long as *any discharge exists*, sexual congress is unsafe.

Pathology.—While the gonorrhœal inflammation attacks very commonly the straight part of the urethra, and may indeed go no further, the gleety discharge is more frequently the product of changes going on at a deeper seat—the neighborhood of the bulb.

Sir H. Thompson remarks: "Observation demonstrates that the two spots which suffer most from gonorrhœal inflammation are the fossa navicularis and the bulb. [By this of course is meant the so-called bulbous portion of the urethra and not the bulb of the spongy body itself. The region alluded to includes the posterior part of the spongy urethra and the beginning of the membranous portion, a tract which not only suffers during the acute stage, but also, and as a consequence, is the frequent seat of coarctation later. As the urethra passes above and not through the bulb, the term "bulbous" as used to designate a definite urethral area, should be discarded from surgical nomenclature.] I have had opportunities of observing this two or three times in the dead-house, on the bodies of patients who had been suffering from gonorrhœa shortly before death. Unusual vascularity is found in the latter situation, particularly if the affection have been chronic, while the intermediate part appears comparatively very little affected. There is a preparation in the Museum of St. George's Hospital which exhibits the urethra of a patient who died while suffering from gonorrhœa, in which an ulcer exists (the only one to be seen) in the commencement of the membranous portion."[1]

A well-marked attack of gonorrhœa in the male may be termed a severe local disease, and rarely terminates in less than three months if no treatment has been applied.

The reaction of the disease upon the system varies very much in different individuals, and in different attacks in the same person. In some cases, a well-marked pyrexial state attends the inflammatory stage of the complaint. Generally, however, there is a comparative if not entire absence of constitutional symptoms. There is certainly a marked tendency to depression of the general health; anæmia is induced, and the sufferer has a pallid and listless appearance of face. These effects will be more markedly evidenced in delicate subjects.

Varieties of the disease.—A variety of gonorrhœa has been described as a "gonorrhœa sicca." It must be very rare, and it has not fallen within the observation of the writer. The symptoms would be those of inflammation, such as heat, redness, and swelling of the parts, with scalding in voiding urine and painful erections, but without the discharge which forms so prominent a character of the ordinary form of gonorrhœa.

Gonorrhœa externa, or balanitis, is an inflammation of the surface of the glans and mucous lining of the prepuce, attended with profuse discharge. It may arise from the same causes as the urethral form, and is particularly apt to occur in persons possessing a long prepuce. A similarly diseased state may be induced by want of cleanliness; a retention and decomposition of the secretion from the preputial glands; and sometimes it occurs as an indication of disordered health.

In severe cases the prepuce may rapidly

[1] Stricture of the Urethra, p. 84.

inflame and swell, with great pain and febrile symptoms, phimosis being induced. In chronic balanitis with phimosis, it is frequently found, upon exposure of the mucous lining of the prepuce, that it is rough, fleshy, and studded with granular prominences.

Excoriations and erosions of the glans and prepuce are frequently present, and it is of great importance to remember that a balanitis with such erosions may be the precursor of general syphilis. [By this is meant that the erosion in such a case would be the so-called "chancrous erosion," a variety of the initial lesion of syphilis which is not infrequent.]

Upon the glans penis an erosion or rawness is often only a primary sore, and induration of the preputial tissues may appear subsequent to the healing and at the base of the excoriations, so that under such circumstances we must always give a very guarded diagnosis and prognosis.

The treatment of balanitis may be summed up at once. It consists of perfect cleanliness with frequent injections of warm water or an astringent lotion. Lime-water is a good application when there is much inflammation. When there is much discharge without inflammation, dusting the parts with a mixture of finely-powdered calomel and calcined magnesia is a capital treatment. It can be applied at night, and removed by an astringent wash in the morning. [A powder consisting of ten grains of opium to a drachm of lycopodium has been found most satisfactory.]

If the excoriations have not healed in a few days, a solution of nitrate of silver (gr. xx to ʒj in the ounce) will generally answer the purpose. [The same solution thrown under the foreskin, when an inflammatory phimosis exists, will be found to remove the pain and swelling very expeditiously. One or two injections are generally sufficient, and should be followed by the use of an astringent, such as zinc or lead.] A saline aperient and rest are often indicated.

Before passing to the general question of the treatment of the disease, we must briefly notice several complications which may occur.

1. There may be severe irritation or actual inflammation of the urinary organs, sometimes of the deeper portion of the urethra, producing great pain in the perineum, with spasm of the external and internal layer of muscles, during micturition. This may cause such pain and difficulty in voiding the urine as to occasionally produce complete retention.

[It may be accepted as a rule, without exception, that this form of retention occurring in a person not previously the subject of organic stricture never requires for its relief the use of the catheter. Leeches to the perineum, hot hip-baths, opium and belladonna by suppository, bromide of potassium internally, or a few whiffs of chloroform by inhalation, will singly or collectively suffice in every case to relax the spasm and to do away with the necessity for instrumental interference, which, in the inflamed condition of the mucous membrane, is sure to aggravate all the symptoms, and may be followed by most serious results.]

Sometimes the bladder is affected, causing a constant desire to make water, and pain in doing so, which lasts for some time afterwards, together with mucous deposits in the urine. Or there may be symptoms of renal irritation, marked by pain in the loins, pyrexia, vomiting, and bloody, albuminous, or purulent urine. This state, with or without symptoms of vesical inflammation, is likely to be induced by strong or untimely injections, absence of rest, alcohol, and the use of large doses of copaiba.

2. Hemorrhage from the urethra. This is likely to occur during chordee, or violent erections, from rupture of some of the distended vessels. It is rarely large in amount, and exercises a beneficial influence rather than otherwise. In passing, it may be remarked, that the green hue of the urethral discharge is probably due to altered hematine being mixed with the pus.

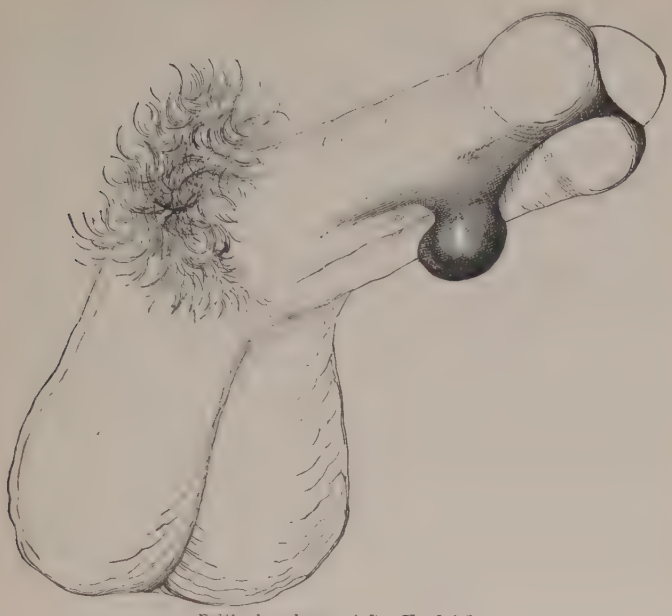
[Hemorrhage at the end of urination is often met with during the acute stage. It is due to superficial ulceration of the urethra, results from the contraction of the circular muscular fibres during the expulsion of the last drops, and yields readily to the employment of emollient and protective injections.]

3. Inflammation, leading to suppuration of some of the mucous follicles of the urethra. Sometimes this is confined to a follicle; sometimes an abscess forms both in this and the neighboring tissues subjacent to the mucous membrane. The swelling thus arising may greatly impede the flow of urine, until it bursts either into the urethra or externally. [Fig. 514.]

4. Inflammation of the lymphatic glands—constituting some form of bubo. Buboes generally make their appearance during the second or inflammatory stage. They are of rare occurrence, except in persons of delicate constitution and lax habit, or when the patient has neglected to rest during the disease. One or more inguinal glands enlarge and become tender, causing uneasiness in the erect position. The areolar tissue and skin around such glands become red and inflamed. If the patient maintains the recumbent posture, and counter-irritation—such as painting the part with a strong solution of iodine, or a blister—be applied,

an abscess is generally avoided. In strumous, lymphatic, and debilitated subjects, an abscess will sometimes occur; or one of the glands will become much and chronically enlarged, the superimposed tissues slowly inflame, and abscess with

[Fig. 514.



Follicular abscess (after Hardy).]

sinuses may follow. [When suppuration occurs, it is generally in the cellular tissue surrounding the gland, the inflammation of the latter subsiding by resolution.]

The lymphatics along the dorsum of the penis may be affected also. These vessels may be felt enlarged; but not indurated, as in chancre; the areolar tissue about them inflames, and the skin is generally engorged and red; the pain and tenderness are plainly marked; and sometimes an abscess occurs at the root of the penis. When an involuntary erection occurs, these inflamed lymphatics may prevent the equable expansion of the organ, and give rise to a modified form of chordee.

5. Balanitis has been already alluded to.

6. Phimosis and paraphimosis may likewise ensue.

The terms *phimosis* and *paraphimosis* are applied to two exactly opposite conditions of the penis. In the first it is difficult or impossible to retract the prepuce behind the glans penis so as to uncover it; while in the second the difficulty arises in returning the prepuce so as to cover that part of the organ.

Cases of phimosis are referable to three heads: 1st, congenital; 2d, accidental, or acquired; 3d, and not unfrequently, a combination of these two causes, as when some inflammatory disease has attacked the tissues of the prepuce or glans, and so either diminished the calibre of a naturally narrow orifice, or increased the dimensions of the contained part.

The congenital form is very common. In some cases there is not only a narrow orifice to the prepuce, but this is associated with adhesions between the opposed mucous surfaces of the glans and its covering. The majority of cases, however, are dependent upon the narrow orifice only, but there generally exists at the same time a redundancy of preputial tissue.

Although this congenital condition is compatible with perfect health, and may give rise to no obvious inconvenience, still, it is a frequent source of irritation from a retention of the secretions, and must without doubt increase the liability to disease from sexual intercourse.[1]

[Although early circumcision is of advantage in cases where reflex troubles arise from adherent prepuce or accumulated smegma, with balano-posthitis, it is open to some serious objections when performed indiscriminately, either as a religious rite or as a prophylactic measure against future venereal contamination.

[1] See Mr. Hutchinson's interesting statistics upon syphilis as affecting the Jews, Med. Times and Gaz., December 1, 1855.

Dr. C. H. Mastin, of Mobile, has called attention to the fact that among the Jews, cases of constricted meatus are exceedingly common. In 95 per cent. of examinations of young adults of this race he found that the meatus would admit only instruments of from 10 or 12 millimetres in circumference down to filiform bougies —the medium between these limits being the rule. The fibrous tissue causing the contraction was unusually dense. The evils associated with this condition were —chronic urethral discharges, irritable urethra, spasmodic stricture, etc. He attributes its occurrence to the exposure in infancy of the delicate mucous membrane of the glans to the influence of friction, and the consequent long-continued irritation, which results in a deposit of plastic matter in and around the meatus.]

Most surgeons have witnessed cases in which, where this congenital formation has not been interfered with, it has given rise to some impediment to the discharge of urine; in a few rare cases this has been so great that the prepuce has become the receptacle for a certain amount of urine; when this condition becomes chronic, the preputial tissues may be much hypertrophied and distended from the retention of urine and the irritation which it sets up. Various and manifold are the symptoms and diseases which have been referred to congenital phimosis. Into these there is no space to enter; but one may be named as fairly substantiated; it may give rise to atrophy of the glans from impeding its normal growth and development.

Among the evils to which an elongated or adherent prepuce may give rise, there ought to be mentioned vesical irritation, incontinence, or even retention of urine. In young children, prolapsus recti may further complicate the symptoms. [There is now no doubt that many cases of muscular incoördination, spasm and paresis are due to phimosis, as are also occasionally various other disturbances of the nervous system, such as amblyopia, hysteria, hypochondriasis, etc. Hernia is not uncommon as a result of congenital phimosis. Out of fifty such cases selected at random, Mr. Kempe found that in thirty-one there was rupture.] The suspicion of calculus, of course, arises in such cases, which are not infrequent in the practice of large hospitals. The removal of the prepuce by circumcision, and the careful separation of the prepuce from the glans penis, will suffice to cure such cases.

Acquired phimosis depends upon some inflammatory or other disease of the prepuce or glans—particularly in those who naturally possess a long and narrow prepuce. Such an inflammation will give rise to swelling of the glans, or thickening or contraction of the prepuce. Of these accidental causes we have, besides balanitis (whether idiopathic or connected with chancres), secondary sores, vegetations, etc., the widely-spread induration of a chancre, and the contraction arising from the cicatrization of these, more especially when they have been seated upon the margins of the prepuce.

In relation to this subject may be noticed a localized hypertrophy of the preputial tissues as a sequence of chancre of those parts. This consists of an ill-defined, diffused thickening, with or without a small amount of œdema, and is essentially chronic. Of course such a state might induce phimosis.

The treatment will be operative or not, according to the cause and degree of the affection. If the glans can be uncovered, then the habit of doing this, with attention to cleanliness, will often be sufficient. In the congenital form, the operation of circumcision may be at once performed. Such is not the case, however, in the forms depending upon accidental causes. The surface of a wound is then apt to be inoculated with the fluid secretions from those temporary affections which have caused the phimosis. The same caution applies to the application of leeches to the inflamed prepuce. By rest, fomentations, a saline purge, and the repeated injection of tepid or cold astringent lotions, or the remedies necessary for the healing of any ulcer, the inflammatory swelling and, with it, the phimosis disappear; if not, we have recourse to operation.

The operations for phimosis are of two kinds, according as we seek to reduce the length of the prepuce at the same time that we give it a free movement over the glans penis, or as we simply desire to effect the latter object.

Circumcision is the operation required in children, and it is best adapted for adults also when the skin is redundant and the margins of the preputial opening are thickened. Different plans of operating have been devised.[1] One of the simplest and best is the following:—

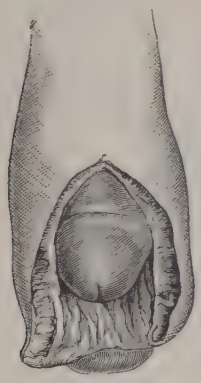
The prepuce is to be seized with the fingers, or a pair of forceps, at its orifice, and drawn sufficiently forwards, when an assistant grasps and compresses it with a stout pair of forceps immediately in front of the glans. The skin being thus put upon the stretch, it is severed with one stroke of a bistoury immediately in front of the forceps. The mucous lining, which will be found to be still undivided and covering the glans penis, is then to be cut upwards from the orifice, by means of a pair of blunt-pointed scissors, or by a

[1] See the preceding essay, p. 957.

bistoury on a director, and the frænum is to be snipped through if necessary. Any small arteries are to be tied, and the mucous and tegumentary surfaces are to be connected with interrupted sutures, five or six of which will be necessary. If any adhesions exist between the mucous surfaces of the glans and prepuce, these are to be divided or torn through by stripping the roll of membrane of the latter off the former. In adults circumcision is the best method of proceeding, as it leaves little or none of that disfiguration which is apt to follow the division of the prepuce simply. [The sutures should be removed in from twenty-four to thirty-six hours, the parts should be dressed with laudanum and water, and a full dose of bromide of potassium should be administered at bed-time, for five or six days, as erections are apt to be painful and often cause the stitches to tear through.]

When the prepuce is of natural length and appearance, except that the orifice is painfully tight, Sir W. Fergusson recommends, that "the point of a director should be pushed in front, between the glans and prepuce, about half an inch up, and then a narrow sharp-pointed bistoury should be thrust from within outwards, by which means a wound half an inch in length will be made in the skin." [It will be found convenient to begin a formal circumcision in this manner, afterwards removing the prepuce by a circular cut on a level with the upper angle of the first incision.] "The incision in the mucous membrane will then scarcely appear so long as that in the skin, and it should be lengthened with scissors, and then two, three, or four stitches should be introduced with a fine needle." It is unnecessary, as well as a

[Fig. 515.



Operation for phimosis (Bryant).]

cause of deformity, to divide the parts as high as the corona, as some do, for half an inch answers all purposes. Instead of the above plan it has been recommended to make two, three, or four small cuts through the mucous membrane and prepuce at different parts of its edge. This is at least quite as painful, and certainly a less satisfactory method then that described. Sir B. Brodie was in the habit of recommending the division of the prepuce near the frænum; this operation he thought was attended with less deformity than any other.

It may be well to add a word or two in the way of caution about these simple operations. 1. Sutures ought always to be employed to bring the parts together, with the view of expediting the process of healing, and preventing the contraction which is apt to ensue when the wound is left to heal by granulation. 2. When circumcision has been performed, the small arteries—particularly any in the neighborhood of the frænum—should be ligatured at the same time, because these are apt to bleed profusely afterwards, when the patient gets warm in bed, etc., and so consequences very unpleasant to him and the surgeon may ensue. [When this accident occurs the blood will often be found to have infiltrated the subcutaneous connective tissue of the penis, producing enormous swelling and discoloration of the entire organ. These rapidly disappear, after the ligature of the bleeding vessel, under the use of anodynes and astringent lotions.] 3. In cases where the phimosis has resulted from disease, and where the prepuce is inflamed, œdematous, or where we have reason to suspect concealed chancres, it is well not to operate, because the wound will very likely be inoculated, and take on an unhealthy action. The phimosis in such cases is to be overcome by local or constitutional treatment. Of course, in some cases the division of the prepuce is essential not only for the discovery and treatment of the diseases which it conceals, but in order to prevent or limit a destruction which may be threatening from the pressure and constriction of the engorged prepuce and the retention of foul discharges beneath it.

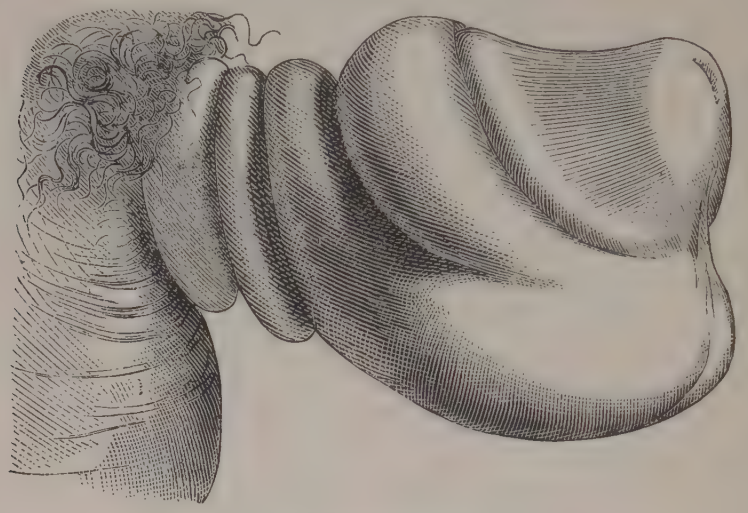
The condition known as *paraphimosis* occurs thus: a narrowed and difficultly retracted prepuce, perhaps, is drawn beyond the prominent edge of the corona glandis; in a short time the circulation becomes so impeded by the pressure of the constricting preputial orifice, that tumefaction ensues, with the effusion of serum and lymph, to such an extent as to bury the seat of stricture in a deep furrow. The consequences will then depend upon the tightness of the stricture, its duration, and the amount of inflammatory swelling. Ulceration, or extensive sloughing may ensue, by which the stricture is

relieved at the expense of much loss of tissue and horrible pain.

If we look at the penis so affected, we notice that immediately behind the glans there is a prominent roll or collar of mucous membrane, with another, though less prominent, swelling of the integument beyond this, separated, the one from the other, by a narrow line or furrow. It is at the bottom of this furrow that the constricting cause is seated.

This affection is not uncommon in boys.

[Fig. 516.



Paraphimosis (after Jullien).]

The treatment will consist in reducing the parts to their normal position without delay. We may apply ice, or direct a stream of cold water upon these so as to constringe them as much as possible.

As the proceeding for reduction is, in most cases, extremely painful, chloroform [or ether] may be used. The patient is to be placed upon his back: the glans penis is to be well oiled, and covered with a piece of thin rag. With the fingers of the right hand the glans is to be gradually, but firmly, compressed so as to diminish its size: at the same time with the left hand encircling the body of the penis, the integument is stretched and drawn forwards, while the compressed glans is pushed backwards through the narrow ring. [Fig. 517.]

[The ulceration which occurs takes place in the constricting ring, *i. e.*, in the margin of the preputial orifice, and thus relieves the strangulation. The foreskin cannot be brought forward, however, until absorption of some of the inflammatory products has occurred.

M. Charles Mauriac calls attention to the fact that the large supply of blood sent to the glans, and the anastomosis between its vessels and those of the corpora cavernosa prevent it from suffering from the effects of the constriction.

Mr. Alfred Eddowes describes as follows a plan of treatment which I have found very useful, and which gives rise to much less pain: Take a strip of wet lint about an inch or two inches wide, and envelop the gland and œdematous prepuce

Fig. 517.

Reduction of paraphimosis (Bumstead).

in it, allowing the lint to reach in front of the glans. Then take a piece of elastic, the best being the ordinary round elastic ligature; and commence winding it round the glans from before backwards. Adjusting the elastic evenly and firmly is

easily managed, if the lint be allowed to reach beyond the glans in front, so as to give a starting-point for the elastic to catch hold of. If the swelling be very great, it is better to apply the elastic lightly at first, allow it to do its work, then pull it rapidly off and reapply it more firmly. By this precaution, all unnecessary pain is avoided, though a little more time is required. The great and even pressure of the turns of elastic very soon reduces the swelling. If the elastic and lint be quickly removed, the glans will be found shrivelled up, and the prepuce readily passes over it.]

Should this not succeed—which it generally will—the seat of stricture can be divided by directing a narrow bistoury flatwise beneath it, and then turning the edge upwards; or by cutting through the stricture upon the dorsum of the penis at the bottom of the furrow. It may be necessary to do this in more than one place, and at the same time to evacuate effused fluids by scarifications and punctures.

[Even when this operation has been performed it will usually be found impossible to reduce the paraphimosis, if it has been of any considerable duration, as the inflammatory lymph retains it in its abnormal position.]

7. *Chronic inflammation of the prostate* is an occasional result of gonorrhœal or gleety inflammation.

To Mr. Adams's work[1] the reader is referred for a very full and admirable description of it, as well as to an excellent article by Mr. Ledwich.[2] See also DISEASES OF THE URINARY ORGANS, p. 771.

[In Prof. Zeissl's opinion chronic gonorrhœa never exists without a moderate tumefaction of the prostate. Individuals who have very frequently had gonorrhœa, or in whom gonorrhœa has persisted for a long period, are said to be the subjects of a considerable enlargement of the prostate in their thirty-fifth year, and often even younger; the growth being due to the persistent hyperæmia of the parts during the prolonged urethritis.]

The inflammation is blennorhœal in type, leading to the discharge of a clear, transparent, or slightly turbid viscid mucus.

This discharge may be sufficient to stain the linen, and is very apt to escape during the act of defecation. It is *not* semen, as it contains no spermatozoa. The disease gives rise to a sense of weight in the perineum, symptoms of irritability about the neck of the bladder, a peculiarly exalted sensibility of the prostatic portion of the urethra on passing instruments, and is almost invariably accompanied by physical and mental languor and depression of spirits, sometimes amounting to hypochondriasis.

The treatment will consist mainly in obtaining the patient's confidence, and disabusing his mind of morbid fears as to impotence. Attention to hygiene is important; sea-air and bathing, exercise, the regulation of the bowels by cold-water enemata or an occasional dose of sulphate of magnesia, the use of a full-sized bougie or sound, and the administration of the remedies indicated for gleet—particularly turpentine, the muriated tincture of iron, strychnia, and tinctura lyttæ. If these fail, Lallemand's porte-caustique may be used. The author has found considerable benefit in these cases from touching the prostatic portion of the urethra with dilute solution of the perchloride of iron. This does not give the pain, and is free from some of the other inconveniences, attending the use of caustic.

[Ergot, in combination with iodide of potassium, has been strongly recommended in these cases as tending to restore the contractility of the prostate, and, at the same time, to favor absorption of the plastic material deposited in it. When all these remedies have failed, the application, once a week, for six weeks to two months, of a gentle faradic current to the prostatic urethra, by means of a urethral electrode, is often sufficient to remove all symptoms.]

Gonorrhœa is not, ordinarily, attended or followed by any cutaneous diseases. The writer has, however, noticed the appearance of a papular erythema in many cases—not depending upon the administration of balsam of copaiba. The subjects of it were suffering from those dyspeptic symptoms so very commonly present in diseases of the genito-urinary organs, and, in the writer's opinion, the eruption was symptomatic of the gastric disease. It is characterized by dull red or pinkish-yellow spots, of various but medium size, and sensibly elevated above the surface. The color disappears under pressure of the finger, and slowly reappears upon its removal. Sometimes these spots are mingled with the larger wheals of urticaria. The eruption is rather sudden in its appearance; ordinarily does not last more than a few days, and leaves no copper-staining.

8. *Herpes preputialis* is not an uncommon affection, and requires a few words of comment here, on account of the similarity of its appearance to the incipient forms of primary chancre.

It is known by the appearance of small vesicles upon the internal or external surface of the prepuce.

[1] Anatomy and Diseases of the Prostate Gland, 1853.

[2] Dublin Quarterly Medical Journal for August, 1857.

The disease commences in the form of several red inflamed spots, upon which minute globose vesicles appear. These vesicles are generally arranged in groups or clusters of two, three, or four.

The affection runs the ordinary course of herpes, but the serous fluid, instead of being absorbed, becomes sero-purulent, and (after rupture of the vesicle) desiccates into a thin scaly incrustation, or leaves an extremely superficial erosion. A circle of vesicles sometimes surrounds the orifice of the prepuce, which is then apt to become fissured and abraded. This affection is accompanied by more inflammation when seated upon the mucous membrane than upon the external skin, but rarely lasts longer than four or six days.

According to Dr. Burgess, a similar herpetic affection attacks females about the pudendum, appearing upon the external aspect of the vulva or on the mucous membrane internally. This may be mistaken for prurigo.

The diagnosis from incipient chancre—not by any means always easy when the period of observation is very limited—will be determined by the number and appearance of the vesicles, their arrangement in groups, the non-inoculability of their fluids, and their speedy cure by simple remedies, such as sulphate-of-zinc lotion (gr. iij to iv to the ounce), with a little lint for protection against friction. [Lotions and ointments in the majority of cases are not nearly so useful in the treatment of this affection as some desiccant powder, such as oxide of zinc and starch, tannin and starch, or, when there is much itching, opium and lycopodium.]

9. *Epididymitis*, or swelled testicle, gonorrhœal rheumatism, and the two forms of ophthalmia—one an acute purulent conjunctivitis; the other an affection of the deeper fibrous textures of the eye, rheumatoid in character, and allied to gonorrhœal rheumatism—are treated of in other essays.

For the sequelæ of gonorrhœa, such as stricture, spermatorrhœa, warts, etc., the reader is referred to the essays on Diseases of the Urinary Organs, of the Male Organs, and of the Skin. [M. Desnos has reported a case of endocarditis following gonorrhœa, and Dr. Marty has collected ten cases in which disease of the heart or pericardium developed within four or five weeks after the commencement of a gonorrhœa.]

The diagnosis of gonorrhœa is not ordinarily attended with any difficulty. When there is phimosis, the discharge may be furnished from the urethra, or from chancres within the prepuce, or both. We must feel for any localized sore or hardness, examine into the state of the inguinal glands, or wait until, by rest and soothing injections, the prepuce can be retracted.

The diagnosis between gonorrhœa, and a primary syphilitic lesion of the urethra so deeply seated as to be undiscoverable upon forced dilatation of the meatus, is difficult, if not impossible. But it has not as yet been proved that a true Hunterian or infecting chancre ever occurs at so great a depth in the urethra; and the diagnosis between a non-infecting sore and gonorrhœa would not be important. [The comparative scantiness of the discharge, which is streaked with blood, the limitation of the ardor urinæ to a small area, the engorgement of one or more inguinal glands, the absence of chordee and of vesical symptoms, should serve to distinguish a deep urethral ulcer, if it be admitted that such cases occur.]

Treatment of gonorrhœa. First stage. Abortive treatment.—We are met at the outset by a question as to how far this is justifiable. By one party the practice is as loudly vaunted, as by another it is utterly condemned. If truth ever rests in extremes, the latter contains the largest measure of it; but the question really lies between the indiscriminate use and abuse of remedies to this end, and their judicious application in carefully-selected cases. This much may be safely said, that in practice it is rare to meet with cases at a sufficiently early stage to justify the use of injections.

When, however, the symptoms are such as have been described and no more, the use of astringent injections will no doubt often abort the progress of the disease.

[Every surgeon of experience has seen a number of cases of urethral irritation in which all the early symptoms of gonorrhœa were present, reddened and pouting meatus, muco-purulent discharge, slight tickling or scalding on urination, etc., but in which no general urethritis developed. They are not by any means infrequent, get well under expectant treatment, and cannot on the first visit be by any possibility diagnosed from the commencement of an attack of well-marked gonorrhœa. It is needless to say that the "abortive" treatment aggravates these cases, and gives the patient unnecessary pain and trouble. The evidence in its favor in any case is extremely unsatisfactory, but recognizing the impossibility of eliminating these cases, it is difficult to imagine a conscientious surgeon employing it.]

Considering the severity of gonorrhœa as a disease, its duration, the complications to which it may give rise, and the loss of health and strength which it en-

tails, we are justified in making an attempt to curtail its progress at the commencement.

Spite of the sanction of such men as Carmichael, of Dublin, and M. Diday, the writer objects to the use of strong solutions as injections, believing them to be incomparably more dangerous and no more efficacious than weaker injections. He is in the habit of using these remedies of a strength and nature as recommended by Mr. Langston Parker (*e. g.*, solutions of nitrate of silver gr. j–ij to oz. vj; solutions of sulphate of zinc gr. iv–viij, to oz. viij, or diacetate of lead gr. xx to oz. viij); and, as far as his experience extends, he has seen no cause to regret their application. Unless the injection be properly applied to the diseased surface no good can result; and the surgeon should do this himself at first and see that the patient is properly instructed in the mode. Glass syringes, properly selected, or hard India-rubber ones may be used. [Glass syringes are so apt to be poorly made—unequal in calibre at different portions, or with the piston irregularly wadded, that they should never be ordered. Any syringe with a nozzle is objectionable, as by mechanical irritation the inflammation, which is at first situated in the fossa navicularis, is augmented.

Fig. 518.

Sigmund's urethral syringe.

A syringe made of hard rubber, containing about three drachms, and of the shape figured in the cut, is by far the best, at any rate for acute cases. Even more objectionable in the early stages than the glass syringes are the soft-rubber tubes, 2½ to 3 inches in length, which are extensively advertised, and which, by passing beyond the actual seat of the disease, deposit the injection at an unnecessary and useless depth in the uterus.] The patient should have passed his water a short time beforehand, and be directed to avoid doing so directly afterwards. The distance to which the injection is to penetrate may easily be regulated by compressing the canal at the required point. The injection should be used every three or four hours, and the patient seen at least once daily by the surgeon. Mr. Durham has lately invented a syringe, which throws the injection *outward;* a continuous stream may thus be kept up without any danger of the injection passing too far along the urethra. Some surgeons have reported excellent results from these continuous injections, which may also be applied with a common syringe if the urethra be compressed in front of the scrotum. During treatment the patient should be directed to remain recumbent as long as possible, to live upon a farinaceous diet, and to avoid meat, condiments, coffee and all stimulants, particularly beer. If the bowels have not been already acted upon, it is right to begin with that, and to prescribe an antimonial saline mixture, containing sulphate of magnesia, potassio-tartrate of antimony, and acetate of potash, in sufficient doses to nauseate slightly and relax the bowels without active purging. The patient is better also for drinking plentifully of any diluents of a mucilaginous nature.

The discharge is augmented after the first few hours' use of the injection, and the urine scalds. By about the second day the disharge is perhaps slightly tinged with blood. The injections should then be stopped; but the medicine and precautions as to rest and diet require more than ever to be attended to.

From this period, if the practice is to prove successful, the discharge will diminish, and in about three or four days cease. Should it, however, be diminished, but nevertheless continue, and either no, or very trifling, inflammatory symptoms be present and still limited to the neighborhood of the meatus, the patient may use a weak solution of sulphate or acetate of zinc. Merely washing out the urethra frequently with tepid or cold water is very useful, inasmuch as the contact of the secretion is by itself a cause for the propagation of the diseased action. If the smarting be such as to render the further use of injections doubtful, these ought at once to be relinquished or replaced by an injection of sub-nitrate of bismuth with a little extract of opium and mucilage. [The sub-nitrate of bismuth, which is a crystalline salt, so far from having a sedative effect, is often very irritating to an acutely inflamed urethra. It is, however, one of the most useful applications to certain chronic cases.] These ingredients act as a local sedative and mild astringent, besides forming a coating to the sensitive mucous membrane.

It is to be distinctly understood, then, that the stage to which these agents are applicable is always a very limited one, and varies somewhat in different cases; that their use presupposes an absence of inflammatory symptoms; an absence of pain in passing water, as well as of any such swelling of the lips of the urethra as to cause pain or difficulty in inserting the nozzle of the instrument.

Some persons use at this stage large doses of such anti-blennorrhagics as copaiba or cubebs. This is a practice of

which the writer has failed to appreciate the utility, and which he considers dangerous, as in almost every case a good deal of derangement of the digestive system ensues from them, and, not infrequently, symptoms indicative of congestion and irritation of the kidneys.

If, however, any one thinks that he makes "assurance doubly sure" by their administration, let him use a preparation of cubebs which is comparatively exempt from these liabilities to mischief.

Second, or acute stage.—In the first place, to secure perfect rest in the recumbent posture is most important. In practice, unfortunately, this cannot often be done. All exercise should be avoided as far as possible. The genital organs should be properly supported in a well-fitting suspensory bandage.

The diet should be scrupulously low and unstimulating, as a rule throughout, to which there are no exceptions at the commencement of this stage. The bowels should be well opened, and during the treatment maintained in a relaxed state. Should the inflammatory symptoms be markedly severe, and out of proportion to the amount of discharge, and at the same time attended with much spasm of the urethral muscles, and scalding in voiding urine, the application of six or twelve leeches to the perineum affords great relief, although their use is not necessary. [The relief of pain may be hastened by tepid sitz-baths, and the patient should be instructed to empty his bladder while in the bath, as in many cases the ardor urinæ under these circumstances will be absent or greatly diminished.]

The patient should either not wear pieces of lint over the meatus, between the glans and foreskin, or very frequently indeed change these. The contact of lint soaked with pus is apt to induce balanitis and phimosis, if it have not also an injurious effect upon the urethral mucous membrane, by impeding the exit of the discharge.

[Absorbent cotton is open to neither of these objections, and, when there is a long prepuce, is by far the best dressing, a little wad, which should be frequently changed, being laid against the meatus. Warm wrappings, tightly-encircling bands, and, above all, rubber or oiled-silk coverings should never be employed.] Of the local applications, none is better nor more soothing than that recommended by Mr. Milton, viz., the application of water, as hot as can be borne, to the genital organs.

The patient should drink frequently barley-water or linseed-tea, to which some mucilage has been added. At this period, saline diuretics, alkaline in character, are almost essential. The writer prefers a mixture of acetate of potash, tincture of hyoscyamus, and nitric ether, to which a small amount of antimony may be added or not. [Bicarbonate of soda, bromide of potassium, tincture of belladonna, and citrate of potash, with or without a little aconite, constitute a most admirable mixture for this stage. It should be continued well into the second stage; delay in the use of cubebs or copaiba being much preferable to their premature employment.] As soon as the scalding in micturition, swelling of the penis, and urgent symptoms are subsiding, the anti-blennorrhagics may be commenced. Their administration, upon the one hand, before the decline of inflammatory symptoms would be most injurious and injudicious; but, upon the other hand, we need not wait until the absence of them in the third stage is pronounced. If the balsam of copaiba be used we need not exceed one drachm doses, three or four times daily; and half that quantity may be used at the commencement.

One of the most useful forms for the administration of copaiba is that in which the balsam is combined with sulphuric acid. Fifteen minims of dilute sulphuric acid may be added to half a drachm of copaiba with some infusion of roses and mucilage. The medicine will act with more certainty in this way, will be better tolerated by the stomach, and will not be so disagreeable to the taste.

The administration of copaiba in any form will occasionally be followed by a rash upon the skin. This often causes the patient great uneasiness, as he fancies that he is affected with secondary symptoms. The rash appears suddenly in small red patches, more or less circular, and somewhat resembling the ordinary nettle-rash in character. It never produces any serious consequences, and generally its appearance is followed by diminution of the discharge and other local symptoms. When this rash makes its appearance the use of the copaiba is usually discontinued, and a saline purgative ordered. If it be desirable to remove the eruption speedily, a warm bath will usually accomplish the purpose.

During the inflammatory stage injections are quite out of the question; but if the scalding be not very great, and the lips of the urethra not much swollen, there is no objection to injecting, with great gentleness, a tepid solution of the extract of opium, or, as directed by Bumstead, this with the addition of glycerine.

[The treatment of this stage of gonorrhœa, according to the French school led by Diday, is very properly almost purely expectant, but the time which they assign to it seems ridiculous, the mean duration being placed by them at about

six weeks, during which interval it is said no repressive measures either by the use of injections or the administration of blenorrhagics are allowable. Certainly the average time required for the cure of cases of all degrees of intensity should hardly exceed a month under the general line of treatment here advised.]

The most efficacious plan of treating chordee, when it arises, embraces the following points: to see that the patient has a well-ventilated room, and is as lightly covered with clothes as is consistent with comfort; the avoidance of any supper or drinks for some hours before bedtime, and the use of a hard mattress; to direct the patient, on going to bed, to bathe the parts with very warm water, and to continue to do so until a sensation of faintness is induced, if possible. [In addition, the patient should always endeavor to secure a movement of the bowels just before retiring, the most effective of all preventive measures.] Of the medicines directed to the prevention of this symptom, the best is camphor in a liquid form, as directed by Mr. Milton (one drachm of the tincture in water before going to bed, and a repetition of the dose every time the patient wakes with chordee). Lupulin may also be given, in ten or fifteen grain doses, before bedtime. It is less likely to disagree with the patient, but is inferior as a remedy to camphor. Perhaps the most efficacious remedy is, however, a suppository containing a grain of opium and three grains of camphor. This may be made with cocoa-nut butter and used every night.

[The monobromide of camphor in three to five grain doses is a most useful remedy in these cases—lupulin in fifteen to twenty grain doses is also a valuable sedative to the genital organs, and gelsemium in the dose of ten minims of the fluid extract repeated every time the patient wakes with chordee has in my experience been extremely efficacious. None of these remedies, however, are so certain in their effects as bromide of potassium, which seems to have fallen into disuse. Its employment as an alkali, as an arterial sedative, and as an anaphrodisiac is especially indicated in the early stage of gonorrhœa, and should never be neglected even when the symptom of chordee is absent. When that complication exists, the dose of bromide should be increased until decided drowsiness is produced, and it should be given during the day, with a double dose either alone or combined with belladonna at bed time. Under this treatment the patient will rarely have any erections, painful or otherwise.]

Third stage.—The most important part of the treatment of this stage consists in the use of injections, at the same time that copaiba, cubebs, or other remedies are administered.

Very different opinions have been expressed as to the use of injections. By some it is thought that these are a fruitful source of stricture. A certain amount of truth appears to be present in this opinion; for of the soldiers treated in Her Majesty's army-hospitals, but few suffer from stricture; while among officers, who use injections to a far greater extent, stricture is not infrequent. This is only apparent, however; for a structural change in the urethral tunics is the result of some preceding inflammatory process; and the more chronic such morbid process has been, the more likely it is that stricture will result. So far as injections are curative of inflammation, so far will they tend to prevent its occurrence. When by injudicious use they have aggravated or maintained the existing disease, or when they have produced a temporary freedom from discharge, and the patient has been deceived, on this very account, into believing himself cured and has acted accordingly, no doubt they may so far tend to the production of stricture.

The writer firmly believes that, when used with ordinary care and judgment, injections are among the very best and most reliable agents we possess for the cure of gonorrhœa.

It is to the third stage of the disease that they are particularly applicable; and the following affords a sketch of the writer's plan of treatment of that stage.

The urgency of the inflammatory symptoms passed, but the entire absence of such symptoms not pronounced, the patient should commence with an injection of bismuth and mucilage (bismuth subnitr. xx gr. to j oz.), to which a little morphia, extract of opium, or belladonna, has been added. This may be injected thrice daily, and the patient be directed to cleanse the urethra also by an occasional injection of cold water. After a few days, this injection is to be exchanged for one of sulphate of zinc (j gr. to j oz.), and the strength of this gradually increased to iv grs. to j oz. If the patient has progressed to a certain extent with this, but then remains stationary, a variety of injections may be tried, inasmuch as change in itself appears useful. The chloride of zinc injection, as recommended by the late Mr. Lloyd, is an excellent one (j–ij grs. to iv oz.). The injection so long in use at the old Lock Hospital, of sulphate of zinc and acetate of lead, xxx grs. of each to vj oz., is a very good one. Alum and vegetable astringents are of inferior efficacy. The writer does not commonly use nitrate of silver as an injection; but if others have been

tried, a weak solution (j–ij grs. to j oz.) may be employed.

Recently the sulpho-carbolate of zinc, in the proportion of two or three grains to an ounce of distilled water, has been used, and has proved very efficacious.

[As a general formula for the employment and selection of injections in uncomplicated cases, it may be said: Begin the use of injections when the ardor urinæ commences to subside; use at first hot water or hot flaxseed tea, thrown in with a syringe without a nozzle—the American Rubber Comb Co.'s penis syringe, No. 0, or one resembling it, being the best; follow this with a mixture of extract of opium and diluted lead water; when the ardor urinæ has entirely disappeared, use an injection with an insoluble sediment, sub-nitrate of bismuth, oxide of zinc, or, best of all, Ricord's old formula of sulphate of zinc and acetate of lead; and, if any discharge remains after one or two four ounce bottles have been used, conclude with a solution of acetate or sulphate of zinc in rose water, gradually increasing the strength. Never use an injection which gives much pain. Be sure by personal observation that the patient is competent to employ it. If his urethra will tolerate it, direct that he inject after each urination. Depend more upon persistence and attention to details as regards diet, habits, manner of giving injections, etc., than upon variation in prescriptions.

It may not be useless to give a few formulæ which are adapted to the plan of treatment above recommended :—

℞. Ext. opii aq. ʒj.
Liq. plumbi subacetat. dil. fʒiv.

℞. Bismuth. subnitrat. ʒj.
Glycerinæ, fʒij.
Aquæ ros. ad fʒiv.

(In this formula subcarbonate of bismuth, which is an amorphous and not a crystalline powder, may be advantageously substituted when the subnitrate gives rise to pain.)

℞. Zinci sulphat. ℈ss.
Plumbi acetat. ℈j.
Tinct. opii,
Tinct. catechu, āā fʒiij.
Aquæ, ad fʒiv.

℞. Pulv. zinci oxidi, ʒj.
Acid tannic, ℈j.
Muc. acaciæ, fʒss.
Aquæ ros. fʒiiiss.

℞. Zinci sulphat. grs. viij.
Acid. hydrocyanic. dil. gtt. xvj.
Aquæ ros. fʒiv.

℞. Zinci acetat. grs. xij.
Morphiæ acetat. gr. j.
Aquæ ros. fʒiv.

A few formulæ for internal administration during the successive stages are subjoined :—

℞. Tinct. aconiti rad. gtt. xvj.
Tinct. belladonnæ, fʒss.
Potas. bromidi, ℈viij.
Sodii bicarbonat. ℈iv.
Liq. potas. citrat. fʒviij.
M. S.—Tablespoonful every two or three hours.

℞. Potass. bromid. ʒiv.
Potass. acetat. ʒss.
Infus. pareiræ brav. fʒviij.
M. S.—Two tablespoonfuls every three hours.

℞. Potass. bromidi, ʒss.
Oleores. cubebæ, fʒss.
Ol. sassafrag. gtt. xij.
Syr. acaciæ, fʒij.
Aquæ, ad. fʒvj.
M. S.—Dessertspoonful every four hours.

(In this mixture, copaiba may be substituted for the cubebs, or two drachms of each may be used. The result is unpalatable, but efficacious.)

Various pastes, pills, and powders, containing cubebs and copaiba, are in common use, and offer excellent methods of varying the form of these unpleasant drugs. They are usually known by proprietary names.]

The next most important local measure is the occasional use of bougies. The bougies may, before being introduced, be covered by different kinds of ointment or by the balsam of copaiba. The writer much prefers the wax or the metallic pliable instruments for this purpose. An instrument should be selected of sufficient size to adapt itself to the urethra without distending it; and such a one should be passed (with the utmost gentleness) twice or thrice weekly. The writer has obtained excellent results from this combined plan of treatment.

[The use of soluble bougies, even in the earliest stages, is strongly advocated by some writers on this subject; iodoform, tannin, acetate of lead, carbolic acid, oil of eucalyptus, and various other astringents or disinfectants being mixed with cacao-butter in the requisite proportions. In my hands they have been so inferior to injections in their ability to control the discharge, and have so often, even when carefully adapted to the acuteness of the symptoms, given rise to severe pain and troublesome chordee, that I have entirely discarded them. Their cost too is another serious objection to their general employment.]

If scalding be present, the bougies should not be used at all; if their introduction induces spasms, the attempt must be made at a later date, or the instrument may be left, as far as it has passed, in the hands of the patient for a few minutes, when it can be probably carried on,

without pain, by the most trifling pressure.

As regards medicines, the administration of copaiba or cubebs in some form appears well adapted to this stage.

As stated by Ricord, both copaiba and cubebs seem to undergo some changes in the digestive process which are essential to the development of their curative properties, for injections of these agents are comparatively useless.

It is in the elimination of these agents by the renal organs that they are brought in contact with the urethra and effect a cure.

This was proved by a case in Ricord's practice. A man, the subject of gonorrhœa, had a fistulous opening in front of the scrotum, communicating with the urethra, through which his urine passed. He could, however, close this opening and direct the stream over it through the usual outlet. Copaiba was administered to this patient, and he was directed to pass his urine through the fistula. In the course of a few days the "running" from this part was cured, that from the anterior portion of the urethra remaining. By passing his urine through the whole canal, the anterior portion was also cured.

The writer has frequently appealed to the experience of the patients themselves as to the effect of different remedies; and the result of his inquiries and personal experience has led him to think that, upon the whole, a treatment embracing the use of anti-blennorrhagic remedies—such as copaiba and cubebs, singly or combined—will be found to yield the best results.

The beneficial effects of these remedies may have been overrated, but experience confirms their influence upon the disease.

The mistakes that are made with reference to the administration of copaiba are chiefly two, viz., the use of the remedy when it manifestly disagrees with, and is not tolerated by, the system; and its continuance beyond a certain time where no benefit has accrued from its use. If the patient's digestion be much deranged by the balsam, then copaiba may be prescribed in some other form—in the shape of pills mixed with magnesia, or enveloped with a coating of gelatine (capsules as they are termed). A few days will generally suffice to indicate whether the patient can take the remedy. If his system revolts against it, only disgust and injury to health can ensue from its continuance. Cubebs will generally be found to agree and answer well in such cases. The dose of the powder is a drachm thrice daily. Another error consists in the continuance of copaiba or cubebs, without benefit, after about a fortnight. Nothing is more certain than that none will result from their further use under such circumstances.

Sometimes a combination of cubebs and copaiba will be found to agree with, and benefit the patient. [This combination is, in my experience, the most active anti-blennorrhagic which can be employed. Capsules containing full doses of both drugs can be administered in almost every case with benefit, and without disagreeing with the stomach. The time for beginning with these remedies is upon the subsidence of the ardor urinæ.] The diet during this stage may be of a good plain description, without stimulants, unless specially indicated. The more the patient continues in the open air—provided this be without much walking—the better; and the daily use of a tepid or cold sponge-bath, and friction with hair-gloves afterwards, are useful.

As the health will almost surely have been impaired by the amount of discharge, loss of exercise, etc., it is almost essential that some preparations of steel be administered towards the close of the case. Such can be combined with cubebs, or given separately. The writer finds a combination of strychnia and iron to be an admirable one. It creates appetite, improves the digestion, and tends to keep the bowels regular, rather than confined.

Certain obstacles to success will be met with in different cases. These may be classed under two heads: 1st, local causes. Sometimes the use of injections appears injurious. The patient suffers from pain along the urethra, irritability of the bladder, and sense of weight in the perineum. Injections must then be discontinued; an alkaline diuretic, with hyoscyamus, and an occasional warm bath being substituted for them. After waiting for a short time, other attempts may be made with injections of a weaker kind; and here the use of bismuth is indicated. Sometimes the use of injections in any form is injurious. The irritation caused by frequently inserting an instrument within the meatus; the contact of an astringent with the mucous membrane; and the direction of the patient's attention to his disease, may all tend to protract the disorder or exaggerate the importance of otherwise trivial symptoms. The presence of stricture, or obstruction of any kind, may have to be determined and overcome by appropriate treatment. Sometimes the discharge is kept up by a congested state of the prostatic part of the urethra, and a blenorrhagia of that and neighboring glands. [If the *prostatic* urethra be clearly the portion involved in this catarrhal condition, and if there be no anterior coarctation, the use of sounds will often aggravate the trouble. Persistent instrumentation under these cir-

cumstances has, in my observation, so frequently resulted in a chronic prostato-cystitis, that sounds should not be employed; the most efficient treatment consisting in the administration of alkalies and sedative diuretics in combination with copaiba-cubebs in sandalwood oil. Of course, if the prostatic catarrh is kept up by a stricture in the membranous or penile portion of the urethra, that condition must be remedied.] The treatment will best consist of Canadian turpentine in ten-grain doses two or three times daily; the passage of a metallic sound greased with a little oxide-of-zinc ointment (one dr. to one oz. of lard); and the use of strychnia and iron. In some cases, where the antiphlogistic treatment and regimen have been carefully attended to, the inflammatory symptoms are of unusual duration, and appear to be unaffected by remedies. This is particularly observed in clear-complexioned persons, or those of sanguine or lymphatic temperaments. In such cases we must adopt an expectant plan of treatment. We may give pil. saponis c. opio night and morning; iodide of iron with sarsaparilla; endeavor to establish a copious diuresis by making the patient drink a tumbler of cold water three to five times daily; use injections of opium or belladonna in glycerine; and let the patient enjoy as much sunshine and fresh air as practicable.

The obstacles to success arising from constitutional causes, are debilitated states of system, engendered by the disease itself, too much meditation, low living, and absence of air and exercise; as well as those congenital or acquired states of system which place the patient in the same category.

Too much importance cannot well be given to our efforts for raising the standard of health by every means in our power. How often it happens that a patient's recovery is protracted from over-medication in every way! Change of air and scene; sea-bathing; a tonic regimen (including a glass or two of good port, Madeira, or claret); tonic medicines, particularly preparations of iron, alike establish the general health and cure the local disease.

Blisters have been highly recommended by many, particularly by Mr. Milton; but the writer's experience has not led him to form a high opinion of their efficacy. One caution is worthy of remark, on account of the frequency with which the inquiry is made—smoking is injurious. The writer instituted a few comparative observations upon this subject, and he found, and the patients themselves found, that smoking affected the disease injuriously.

Fourth stage. Gleet.—We must remember that this condition is very apt to be due to errors of constitution, such as the strumous, rheumatic, or gouty diathesis, and modify our treatment accordingly. The remarks made in regard to the constitutional remedies in the third stage will apply with more force perhaps to this. The further use of anti-blenorrhagics is needless and hurtful; while the administration of salts of iron is generally indicated. A combination of the tinct. ferri muriatis with tinct. lyttæ is very good. A return to accustomed exercise in the open air is to be made. So that the patient avoids fatigue and riding, he cannot be too much out of doors. Sea-bathing is generally beneficial. We must endeavor to discover what requires amendment or improvement in the system, and act accordingly. Each case will present a physiognomy of its own. It is necessary to bear in mind the tendency which exists to a return of inflammation, or an implication of other organs, as the bladder, upon the recurrence of exciting causes.

Among the local agents which may be employed with benefit, two are of especial value—viz., the occasional introduction of a bougie, and injections, of which the sulphate, acetate, or chloride of zinc are the best. The writer thinks also that the application of a small blister to the perineum is a useful measure, particularly if the blistered surface be kept open by the use of an irritating ointment.

[The author does not give sufficient prominence to the fact that the vast majority of gleety discharges depend upon the presence of stricture. Time spent in general treatment, as recommended, would often be wasted unless the urethra had been carefully examined, and every coarctation, however slight, thoroughly dilated. As adjuvants, tonics, exercise, change of air, etc., are very valuable.]

Gonorrhœa in the Female.

Gonorrhœa is a much less common affection in women than in men. [Chiefly for two reasons: The mucous membrane of the vagina is not so sensitive as that lining the male urethra, and in addition one of the chief causes of gonorrhœa in the male, the irritation of uterine and vaginal discharges of simple origin, has no analogue among the causes capable of producing gonorrhœa in the female.] And when it does occur, the disease is ordinarily much less severe, and hence more rarely comes under treatment.

A consideration of the very different parts and structures and the different physiological functions of the female generative organs compared with those of

the male, will at once suggest differences in the course and symptoms of this disease in the female. While the urethral mucous membrane is the ordinary seat of gonorrhœa in the male sex, the vagina and vulva are commonly affected in the female. In the male again, gonorrhœa is the result generally of contagion; in the female, vaginal and uterine inflammation and discharges are very common from other causes, and it is impossible to say how many cases in them are the result of contagion, or to diagnose between a discharge the product of gonorrhœal inflammation, or one from other causes.

[It is undoubtedly true that taking a definite number of cases of so-called gonorrhœa in both sexes, more of them are due to infection in the women than in the men. The occurrence of an acute vulvitis or vaginitis in a female renders it highly probable that she has had connection with a man affected with gonorrhœa. The same rule does not apply to the male.]

Dr. West says, "The microscope fails to furnish us with a means of distinguishing between gonorrhœal and simple vaginitis, and no symptom or combination of symptoms is absolutely conclusive on this point." It is imperative upon us to remember that vaginitis with purulent discharges is common enough in children and young females, from various constitutional and local causes, because such symptoms often give rise to perfectly unfounded charges.

Gonorrhœa in the female comprehends varieties, as it is seated in the vagina, vulva, urethra, or uterus.

In the vagina it commences as an inflammation of the mucous membrane, with heat, redness, swelling, and tenderness; and is attended with a secretion at first of muco-pus, afterwards of true pus. Any part of the canal may be affected, particularly the anterior wall beneath the pubal arch; or the whole lining membrane may be involved.

In the vulva the earliest symptoms are, sensation of heat and pruritus; to this a dry and swollen state of the mucous membrane of the vulva and nymphæ succeeds. This stage is very short, and a copious purulent offensive secretion appears. The tumefied state of the parts renders their separation very painful. The various muciparous and sebaceous follicles of the vulva become involved and pour out a copious secretion.

[The sebaceous follicles are frequently seen enlarged and projecting from the mucous surface in little irregular prominences. On passing the finger over the labia they can often be plainly felt when they are hardly visible. If their enlargement is marked they constitute the prominent element of some cases of gonorrhœal vulvitis. (Fig. 519.)]

The vulvo-vaginal glands, known as Duverney's or Cowper's glands, situated upon either side of the entrance to the vagina, become engaged, and besides the copious secretion these may yield, they may become the seat of abscess.

[Fig. 519.

Sebaceous vulvitis (Bumstead).]

[Inflammation of these glands followed by abscess causes the affected labium to assume a pear-shaped appearance, and to project considerably beyond its fellow. Pudendal herniæ and cystic tumors may be distinguished in the one case by the impulse on coughing, in the other by the slow growth of the swelling, in both by the absence of inflammatory signs. The abscess should be freely opened on the proximal surface near the glandular orifice, at which point spontaneous evacuation, when it occurs, usually takes place.]

Mr. Salmon has called attention to cases in which these glands are alone affected. The swollen nymphæ often protrude beyond the labia. [Fig. 520.]

The uterine form is commonly the result of the spreading of the inflammation from the vagina. The canal of the cervix is the part usually engaged. The os uteri is red and patulous, hot and tender. By pressure a very tenacious muco-purulent discharge exudes. Erosions and patches of excoriation are commonly present about the os and outer aspect of the cervix.

Gonorrhœa of the urethra very rarely

exists alone, but is found in common with one or other of the foregoing affections. The meatus is congested, and the canal swollen and tender; some discharge may

[Fig. 520.

Inflammation of the vulvo-vaginal gland (Bumstead).]

be made to exude by pressure applied to the under surface of the urethra against the os pubis, provided the patient has not passed urine shortly beforehand. Scalding is commonly present. The symptoms are less acute than in the male, owing to the shortness and want of complexity of the female urethra; the disease also is less protracted, and does not ordinarily pass into gleet.

[Women will often complain of scalding during micturition, when the urethra is entirely unaffected, and such cases must not be mistaken for, or treated as urethritis. The pain is due to contact of the urine with the inflamed mucous membrane of the vulva and lower portion of the vagina. Involvement of the urethra indicates a more than ordinary degree of contagiousness of the discharge, as the muco-purulent secretion of leucorrhœa rarely sets up a urethritis. It constitutes presumptive but not conclusive proof that the disease has resulted from contact with a purulent discharge from the male urethra.]

Complications.—Inflammation of the inguinal glands from gonorrhœa in the female is rare, and almost limited to cases in which the urethra is affected.

Vegetations and mucous patches are not at all uncommon.

Sometimes it has happened that a vaginitis has induced inflammation in the Fallopian tubes as well as in the cavity of the uterus. West mentions two successive attacks of vaginitis at an interval of eighteen months in the same patient, which were followed by such severe peritonitis as to call on each occasion for the abstraction of blood.

Ovarian inflammation, corresponding to the epididymitis of the male, occasionally occurs. It has been described by Hunter, Dr. Tilt, and others. It is marked by pain, swelling, heat and tenderness on pressure in one or other of the iliac fossæ. There is generally pyrexia; sometimes much nausea; and movements of the abdominal muscles are painful. The treatment of this complication will consist in rest in the horizontal posture; the application of leeches to the tender part, followed by fomentations, and the exhibition of saline medicines with opiates to relieve the pain.

Gonorrhœal rheumatism is rarely, if ever, met with in females; and gonorrhœal ophthalmia appears to be uncommon also.

The treatment will vary to a certain extent, according to the age and character of the patient, the sthenic or other type of the symptoms, and the stage.

In the acute stage perfect rest, salines, low diet, emollient sedative solutions, and strict attention to cleanliness, are required. Leeches are not advisable, as the bites are apt to be inoculated by contact with the discharges—inflammation and troublesome sores sometimes ensuing. As the disease begins to subside, astringent injections may be used; a weak solution of acetate of lead, or the liquor aluminis compositus largely diluted with water. Sometimes a weak solution of nitrate of silver is very beneficial. These injections should be used four or five times daily, in large quantities, and properly applied by means of one of Kennedy's elastic bottles. Pieces of lint steeped in the lotion may also be inserted so as to prevent contact and friction of the opposed surfaces. The exhibition of specifics (copaiba and cubebs) in the gonorrhœa of women is perfectly futile, unless the urethra be affected, and even then they seem to be productive of little, if any, benefit.

As soon as the inflammatory symptoms have subsided, the same injections may be used as have been recommended in cases of gonorrhœa occurring in men, and they may often be used four or five times the strength.

[When the vulva is involved, sedative lotions applied on lint, great attention to cleanliness, and the absolute interdiction of exercise are the main points in treatment. The insertion of syringes is objectionable in the acute stages, but may

be rendered necessary by a vaginitis accompanied with a profuse discharge. In such a case, or after the vulvitis has measurably subsided, the patient should be instructed to take her injections of lead, zinc, alum, tannin, etc., in the recumbent position, with the heels drawn up to the buttocks. A flexible rubber syringe, with a bulb and metallic valves, should be used, so that only one introduction of the tube is necessary. The vagina should first be washed out with tepid water. The injections should, for convenience and economy, be prescribed in the form of powders, the solutions of which should vary in strength from one to two drachms to the pint of water. They should not give rise to pain. After all the acute symptoms have subsided, by far the best way of speedily causing the cessation of the discharge is to pack or tampon the vagina thoroughly with strips of lint, into the meshes of which powdered tannin has been rubbed. These tampons should be removed once in twenty-four hours, or oftener if they become offensive. When it is impossible to visit the case so frequently, astringent suppositories form an excellent substitute for this treatment.']

SURGICAL DISEASES OF WOMEN.

By J. Hutchinson, Esq.

Revised by Alex. J. C. Skene, M.D.

If, perhaps, we except diseases of the eye, no department of surgery has made greater advances within the last fifteen years than that which concerns the surgical diseases of women. In the successful treatment of vesico-vaginal fistula, and the radical cure of ovarian dropsy, we enumerate some of the most creditable achievements of modern surgery.

The space allowed by the present work will not permit of anything approaching to a full dissertation on the various affections peculiar to women, which require surgical treatment. I shall, therefore, endeavor to keep closely to the more important parts of my subject, having regard especially to those diseases which permit of relief by operation. The following will be the arrangement of subjects treated of:—

I. Urethral hemorrhoids.
   [Prolapsus of the urethral mucous membrane.]
[II. Surgical treatment of stone in the bladder.]
III. Malformations of the vagina or uterus.
IV. Uterine polypus.
   [Uterine fungosities.]
V. Uterine fibroid tumors (in reference to surgical treatment).
VI. Malignant disease of the cervix uteri.
VII. Malignant disease of the external genitals.
VIII. Non-malignant disease of the external genitals.
   [Pudendal hematocele.]
IX. Surgical measures in cases of extra-uterine pregnancy.
X. Ruptured perineum, and its consequences.
XI. [Lacerations of the cervix uteri.
   Pelvic hematocele.
   Pelvic abscess.]

[In ordering vaginal injections, it is best for economy and convenience to order the substance to be used in powder, directing the patient to dissolve from half a drachm to a drachm in a pint of water just before using it. As it is not necessary to be very accurate in the matter of proportion, the following approximative ratio between weight and bulk will serve as a guide: A teaspoonful of tannin weighs ʒj; of acetate of zinc, ʒiss; of alum, ʒij; of sulphate of zinc, ʒij; of acetate of lead, ʒiij.

Excellent formulæ for suppositories are as follows:—

℞. Pulv. opii, grs. vj.
   Acid. tannic. ʒj.
   Ol. theobromæ, q. s.
   M. et ft. suppositoria, No. xii.
Sig.—Use one every four hours.

℞. Morphiæ sulphat. gr. iv.
   Liq. ferri subsulphat. fʒij.
   Cerat. plumbi subacet. ʒij.
   Ol. theobromæ, q. s.
   M. et ft. supposit. No. xii.]

XII. Organic diseases of the ovary, and their surgical treatment.
XIII. Vaginal fistula.
XIV. The Cæsarian section.
[Coccyodynia.]

I. Vascular Tumors of the Urethra.

Urethral hemorrhoids, or vascular tumors of the meatus urinarius, are not uncommon in women of any age, though more frequent in young adults. They are sometimes single, but often multiple. They may be pedunculated or on broad bases. Their most frequent site is on the floor of the meatus, but they may occur at any part. They rarely extend far inwards, but sometimes sufficiently so to make their complete exposure difficult. Those with broad bases resemble very closely in all particulars the more vascular kind of piles; but those which have become pedunculated are of more fragile texture, and look more like small nævi. They are, however, never congenital, and in their mode of origin and real nature are probably analogous to anal piles. Their symptoms, also, making allowance for difference in site, are very similar to those of piles. Proneness to bleed, great sensitiveness, liability to become extruded and inflamed, pain during the escape of the visceral contents, are some symptoms which both diseases have in common.

The amount of suffering caused by these little growths is often exceedingly great. In some cases the pain is almost constant; in others it is only excited by irritation, as for instance the passage of urine over the growth. The quantity of blood lost may vary greatly, and in some cases, which are attended by great irritation, it may be very trivial. If a woman complains of pain in passing urine, with occasional bleeding, an examination should always be made, and in most such cases a urethral hemorrhoid will be found.

Very often the irritation produced by these little growths suffices to cause serious constitutional disturbance. In one instance I have known urethral or urinary paraplegia to result; but this event is probably extremely rare.

Those who have had much experience in the treatment of these cases will acknowledge that their complete cure is often not easy. Although the little tumors seem to be very superficial, they are not really so; and unless the submucous base is destroyed, they quickly and pertinaciously grow again. The ligature, excision, and the cautery, either singly or combined, are our chief means of combating them. Whatever method is adopted should be boldly used. The application of any so-called mild caustic, as the nitrate of silver or sulphate of copper, can be productive only of mischievous irritation. The best caustics are the actual cautery or the acid nitrate of mercury; and of these the first is the most manageable, especially if a galvanic apparatus be employed. On the whole, perhaps the ligature is the most trustworthy plan. It must be applied by means of a fine tenaculum, by which the base of the tumor from behind forwards has been deeply transfixed, and over which the silk is applied. If only the crest of the growth be tied, the plan is worse than useless. By whatever plan we propose to operate, it is desirable that the patient should be under chloroform [or ether], and in the lithotomy position, and that the meatus should be well opened by means of bent probes.

[Prolapsus of the Urethral Mucous Membrane.

This is generally a secondary affection. The membrane must be increased in extent, either from relaxation of its fibres or hyperplasia, and its basic attachments must be relaxed before it can become prolapsed.

The size and extent of the protrusion vary considerably. If the meatus is of full size, the prolapsed portion will usually preserve its natural color for a time, but after a little, it will become red and œdematous. When the meatus is small, these changes occur sooner and in a more marked degree, because the prolapsed portion is partially strangulated.

The symptoms of this affection closely resemble those of irritable growths at the meatus urinarius, but it is easily distinguished from such growths by the fact that they are limited to one side, while the prolapsed membrane extends all around the canal.

Treatment.—There are several operations advised for the relief of this affection. Either of the following will answer:—

1st. Draw down the prolapsed tissue, pass a double silk ligature through its base and tie the two halves.

2d. Pass a sound of wood or hard rubber into the urethra, and then encircle the prolapsed tissue with the galvano-caustic wire; remove the mass slowly, keeping the wire at a dull red heat.

II. Surgical Treatment of Stone in the Bladder.

The surgical treatment of this affection, as it exists in women, is all that need be considered here.

There are two methods of operating:

rapid lithotrity—too well known in this country as Bigelow's method to require description here—and vaginal cystotomy. In making a choice between the two operations, the surgeon should be guided by the extent of cystitis present. When there is but little irritation or inflammation of the bladder, Bigelow's operation is to be preferred; on the other hand, where there is cystitis with marked destruction of the mucous membrane, cystotomy has manifest advantages. In such cases the object of the operation is twofold, the removal of the stone and the cure of the cystitis, by maintaining drainage through the opening, which should be preserved until the inflammation subsides. When the operation is performed for the removal of stone, the wound in the vesico-vaginal septum is closed with silver sutures.

Whatever the object may be, the operation is the same, except in the time of closing the wound; hence one description will suffice.

Dr. T. A. Emmet operates as follows:—[1]

"The operation is to be performed under the influence of an anæsthetic when possible, with the patient on the left side, and the anterior wall of the vagina fully exposed by means of a large-sized Sims's speculum. A sound somewhat abruptly curved an inch and a half from its extremity, must be introduced into the bladder and held by an assistant. While the point of this instrument is firmly pressed in the median line against the base of the bladder a little behind the neck, the projecting tissue on the vaginal surface must be seized with a tenaculum, and divided by a pair of scissors directly on the point of the sound until it can be passed through into the vagina. With the sound remaining in the opening as a guide, one blade of a pair of scissors should be passed into the bladder, and the vesico-vaginal septum be divided backward in the median line. By this mode, especially where the vagina is of natural size, the operation is extremely simple, and is completed in a few moments. The object in cutting on the point of the sound is to be sure that the bladder and vaginal surface are divided in corresponding incisions, for there is so much mobility of one surface over the other, that it is exceedingly difficult to enter the bladder unless the parts are transfixed.

"Various means have been resorted to for keeping the artificial opening patulous. I have used in some cases, with advantage, a stud or eyelet made from glass tubing half an inch in diameter, and not unlike a spool in shape, which is buttoned into the slit. The portion of the flange to remain within the bladder requires to be but little more than a slight flare with the edge turned over to keep the instrument in place, while the vaginal rim may be larger, to prevent its slipping into the bladder. It will remain loose, and with sufficient play to prevent the parts from healing up too tightly around it. For its removal only a pair of forceps is necessary, by which one side may be turned up for the other to escape. If used, it should be made light, and only from the finest quality of Bohemian glass. It is really a most useful instrument, but I have been obliged to abandon it on account of the difficulty of having them made from a proper quality of glass. If the least amount of lead or other impurity exists in the glass, it will, in a few hours become encrusted with a sabulous deposit from the urine, and will increase greatly the irritation. As a rule, therefore, I think it advisable at first to rely upon the careful introduction of the finger night and morning, but after a few days, when the irritation of the parts has somewhat subsided, the urine is in better condition, and the incision beginning to close, the glass stud may be used with greater advantage."

Prof. Pallen[1] recommends operating with the Paquelin thermo-cautère, as follows:—

"The main difficulty hitherto has been to keep the incision open after the use of the scissors or knife. Artificial means must be resorted to, such as an India-rubber tube passed from the urethra through the opening, which is annoying and painful, or a glass button introduced, which is difficult to retain, and when retained, is apt to beget vesical tenesmus. I believe the use of the actual cautery at a red heat will be found to answer all purposes. If the platinum tip of the cautery be heated to a white heat, it cuts through as rapidly as the knife, and therefore hemorrhage is to be expected. Besides, the thin slough produced by white heat might peel off and union ensue. To avoid both bleeding and contraction, the tip should be raised to a red heat only, and passed slowly along the side of the proposed opening, dividing first the mucous membrane of the vagina, and then held still for a moment or so to allow the adjacent vessels to contract and become occluded. The submucous connective tissue is then burned, and afterwards the bladder wall itself. Extreme delicacy of manipulation is required upon the part of the surgeon, lest he burn directly into the cavity of the bladder, which should be avoided in order to prevent hemorrhage, contraction and subsequent union."]

III. Malformations of the Vagina or Uterus.

Cases of closure of the outlet of the vagina by adhesion of the labia in the

[1 Principles and Practice of Gynæcology, pp. 731–3]

[1 Kolpo-cystotomy, or Artificial Vesico-vaginal Fistula, Am. Journ. Obstetrics, vol. ix., April, 1878.]

middle line are not unfrequently brought under the notice of the surgeon. In these the anterior part is almost always open, so that there is room for the escape of the urine. The defect is usually discovered by the mother or nurse early, and the patient comes under care either in infancy or early childhood. At this age the adhesions are rarely strong, and may commonly be broken down by a director. The insertion of a strip of oiled lint prevents reuniting of the edges, and the cure is complete.

Ruysch and Delpech have each recorded a case in which adhesion of the labia was the cause of retained menses. In Ruysch's case, if not in both, there is, however, reason to doubt whether the occluding membrane was not an unusually thin and distended hymen. I have seen the hymen in cases of great distension pushed down external to the vulva.

In those cases, however, in which the vagina is closed higher up than the external outlet, the defect is but seldom discovered until menstruation is established. Very frequently the case is allowed to pass on until a large accumulation of retained menstrual fluid has taken place. Amongst the causes which may give rise to the closure of the vagina we may class congenital malformations, imperforate hymen, and adhesion of the walls of the tube consequent on ulceration in early life. The first and the last are much less frequent than the second. It is scarcely necessary to point out that if by chance the fact of the existence of vaginal occlusion should come to the surgeon's knowledge prior to the establishment of menstruation, an early operation is very desirable. We shall have to show very shortly that even the simplest operations, when performed after menstrual accumulations have taken place, are attended with peculiar danger.

In any case of vaginal obstruction it is desirable, first, to ascertain the character, thickness, etc., of the occluding medium; and secondly, to determine, if possible, whether the uterus be present. In a large majority of cases the existence of an abdominal tumor, believed to be an intra-uterine collection of menstrual fluid, at once sets the latter question at rest.

The determination of the presence or absence of the uterus is in certain cases exceedingly difficult. If, however, the patient have attained adult age, and there have been no menstrual effort, and if on careful examination by the vagina and rectum the organ cannot be felt, a strong suspicion must be entertained that it does not exist. This suspicion will be strengthened if the vagina below the occlusion be much contracted, and if the walls of the bladder and rectum above it can be ascertained to be in near contact. The development or otherwise of sexual characteristics is of little value as a symptom, since it depends more upon the state of the ovaries than upon that of the uterus. Should there appear good reason to fear that the uterus is absent, and that the case is one of non-development of that organ and of the upper part of the vagina, no operation should be attempted, since any incisions of sufficient extent to clear up the doubt would be attended with much danger.

When there is evidence of the retention of menstrual fluid, and therefore of the presence of an uterus, and probably of a vaginal cavity above the occlusion, the case will come fairly under surgical treatment. In the first place, the character of the obstructing medium must be determined. If the obstruction be found within an inch or two inches of the vulva, and if it be constituted by a membrane, more or less thick and unyielding, stretched across an otherwise well-formed vagina, the case is probably one of imperforate hymen. In some of these, during coughing, the propulsion of the fluid downwards may easily be felt, or the distended membrane may even be forced as low as the vulva itself. In these cases the operation is in itself easy and simple, though, as we shall see shortly, by no means devoid of risk.

The method of operating in a case of imperforate hymen has usually been to make an incision of a crucial form in the centre of the membrane. The patient having been placed in the lithotomy position, is desired to force downwards, so as to distend the occluding structures, and a bistoury is then plunged into the centre. The opening thus made is subsequently widened, the finger being introduced and used as a director. If there be considerable redundancy of thin membrane, it may be feasible to dissect part of it away; but if otherwise, the free crucial incision will be amply sufficient, and will not be attended by any subsequent inconvenience, due care being taken to prevent contraction during the first week or two. Mr. Baker Brown has advised strongly that the hymen should in all cases be dissected away; but it is impossible to believe with him that, when this is not done, "vaginitis is very apt to be set up by the friction of the surfaces upon each other," and that "this inflammation may extend to the uterus, Fallopian tubes, and peritoneum." Most surgeons will probably incline to the opinion that a free crucial opening is likely to incur less risk of inflammation than an operation in which "the hymen is removed entire by a circular incision;" nor is it needful to point out which of the two methods most closely imitates nature's procedure.

That a free crucial incision is amply sufficient as regards providing free space for all functions of the tube, there can be no practical doubt. Indeed, since no mucous membrane is removed, it is probably less likely to be followed by any thing like cicatricial stricture than would the plan proposed by Mr. Brown. In one case in which I adopted the crucial incision, and in which the diaphragm was very thick, the patient subsequently married, and has since borne several children. At the present time there is not the slightest perceptible narrowing of the vagina at the part.

Although, however, the operation in cases of retained menses from imperforate hymen is easy enough, yet clinical experience has shown that it is attended by much danger to life. In a very considerable proportion of such cases, within a few days of the operation, peritonitis comes on, and death ensues. Whence this risk? That it is not connected with the extent of the incisions or the nature of the parts incised, is quite evident; for it has occurred in some in which nothing was done beyond a mere puncture in a thin membrane. Nor can it be attributed, as Dr. Blundell suggested, to a disease derived by a contagion analogous to puerperal peritonitis, since it has happened in private practice and in districts in which no puerperal disease was prevalent.

Let me cite the following example, which came under my own notice. A very healthy girl, aged sixteen, residing at a village near York, came under treatment in May, 1851, on account of retained menses. On examination a round elastic tense body, the size of an orange, was found protruding between the labia. A common lancet was plunged into the centre of this swelling, and a stream of dark treacle-like fluid without smell followed. About two quarts were discharged. On the second day after the incision slight chilliness occurred; on the third she was feverish, and the vaginal fluid had an offensive smell. On the fifth day the existence of peritonitis was very evident; and she had a rapid pulse and foul tongue. From this date she passed into a condition of low irritative fever, attended with much sickness, etc.; and death took place on the twenty-fourth day. No post-mortem examination was obtained. It was impossible that less could have been done, or under more favorable circumstances, than in this case. Yet it is a good example of what often follows the puncture of an imperfect hymen. In some, death takes place even within a few days of the operation (if such it can be called); whilst in a few the patients, after severe peritonitis, ultimately recover. If ill symptoms have, however, once set in, the chance of recovery is small; the cases which do well (happily a large majority of the whole) usually progress from first to last without any drawback, and without the slightest indication of peritoneal irritation.

Two suggestions occur by which to explain the danger attending this operation. First, it may easily be supposed that the retained menstrual fluid is in a condition peculiarly apt to undergo decomposition as soon as air is admitted, and not unlikely when decomposed to induce a form of endometritis, which might pass on to a condition closely analogous to that of peurperal fever. The second explanation is one that would not have occurred to the mind had it not been demonstrated by post-mortem observation. It is, that some of the retained fluid finds its way upwards, through the free extremity of the Fallopian tube, into the sac of the peritoneum. That in cases of retained menses the Fallopian tubes, as well as the uterine cavity, are often very greatly dilated, has been repeatedly witnessed. But why should a dilated tube which never permitted the escape of its contents before the operation do so afterwards? It might have been supposed that, prior to the incision of the occluding membrane, and that especially during the state of tension produced by a menstrual nisus, the risk of extravasation upwards would be considerable, and that it would cease at once when an outlet downwards was provided. The clinical fact is, however, the reverse; and whilst it is very rare for such escape to take place prior to the incision of the hymen, it is by no means infrequent within a few days afterwards.

To MM. Bernutz and Goupil[1] we are indebted for the best collection of facts and arguments bearing upon this part of our subject. In some instances there has been found evidence of ulceration at or near the free extremity of the Fallopian tube, but in others the fluid could only have escaped from the free extremity itself.

Sir Benjamin Brodie[2] has mentioned two cases in which peritonitis followed this operation. In one, the patient with difficulty recovered; in the other, death took place. At the autopsy in the latter a large quantity of menstrual fluid was found in the abdomen, but there was no rupture either of the uterus or of any part of either Fallopian tube. In a case recorded by M. Locatelli, and quoted by MM. Bernutz and Goupil, full details of the autopsy are given. In this case death followed on the third day. One Fallopian tube was found dilated to the size of a nut, the other to that of a turkey's egg. The latter had ruptured behind, and in the peritoneal cavity was a small quantity of black half-

[1] See their excellent Clinique médicale sur les Maladies des Femmes; article, Rétention du flux menstruel; or, New Sydenham Society's translation, vol. i., p. 1 et seq.

[2] Lond. Med. Gaz., vol. xxvii., p. 810.

putrefied blood, exactly similar to that contained in the tube. The dilated tubes were adherent to their respective ovaries, and communicated with the uterus by extremely narrow canals. Mr. Paget, of Leicester, has also published a case in which a young lady of eighteen died on the fifth day after an incision through an imperforate hymen. At the autopsy the Fallopian tubes and ovaries were found dilated, until each would have held a pint of fluid. Both these tubal-sacs had ulcerated and given way, the edges of the openings looking as if recently torn. In the peritoneal cavity was a pint and a half of black fluid, exactly similar to that removed from the vagina.[1]

In proof that rupture of the distended Fallopian tube may occasionally happen without any operation having been performed, is a case given by Dr. Munk,[2] in which a girl of eighteen, who had never menstruated, died after a three-days' illness, with symptoms of acute peritonitis. There was found after death an imperforate vagina, consequent apparently on cicatricial adhesions. In the peritoneal sac was a large quantity of thick blood, of similar character to that which, to the quantity of about five ounces, occupied the uterine cavity. Both Fallopian tubes were dilated sufficiently to admit a finger, and near the extremity of the left was a small laceration, from which the fluid had escaped.

These cases illustrate clearly the chief danger to which patients after this operation are exposed. The only explanation which can be given as to why these Fallopian lacerations should be so prone to occur immediately after operations is, that the uterus, by its contractions after evacuation, may possibly drive a certain portion of fluid backwards. It may easily be supposed that the tubes already distended and thinned are unable to empty themselves quickly, whilst a powerful organ like the uterus, excited to contraction by the escape of its contents, would rapidly do so, and thus close the apertures of communication.

As I am not aware of any published cases of death after incision of imperforate hymen in which there was post-mortem proof that no escape of fluid into the abdomen had taken place, it seems probable that this occurrence is the main risk which we have to encounter. The problem, how to obviate it, is one of great difficulty. It is not practicable to avoid such operations altogether; and were it so, as Dr. Munk's case proves, no immunity could be obtained. Sooner or later the dreaded event would probably take place. To make a very small incision, and thus allow the fluid to drain slowly off, instead of at once permitting the uterus to empty itself, has been proposed, and with much plausibility. To accomplish this, the introduction of a small drainage-tube by means of a trocar and canula would perhaps be the best method. Still it is probable that, however slow the escape might be, the uterus would claim preference for itself, and act energetically throughout the whole time, thus preventing the evacuation of the thin and feebly muscular tubes. With the view of retarding this action, it might possibly be well to put the patient before the puncture under the full influence of tartar emetic, and to keep her nauseated for twenty-four hours afterwards. Under such circumstances the freer the opening the better. *With the hope of anticipating the dilatation of the tubes, early operations should always be performed in cases of occluded vagina.*

[In the hope of preventing regurgitation of the menstrual fluid through the Fallopian tubes into the peritoneal cavity, and also of avoiding the dangers of inflammation of the uterus and the vagina and of the septicæmia likely to arise from decomposition of the retained material, the following method of treatment has been adopted:—

A free incision of the hymen is made, the fluid is rapidly evacuated and the uterus and vagina are washed out with carbolized water.

Dr. T. A. Emmet has reported four cases successfully treated in this way.[1]]

The above statements apply to all operations in which there has been retention of menses, whatever may have been the cause. Probably they include the only source of danger to which, in simple cases of imperforate hymen, the patient is exposed. In cases of obliteration of the vagina, however, other risks attend any attempt at operative relief. In these cases the operation is in itself a more or less difficult process of dissection, and there is danger that either the bladder, the rectum, or even the peritoneum itself, may be wounded. No two cases are alike, and it is impossible to lay down rules for the surgeon's guidance, beyond insisting upon the necessity of ascertaining as exactly as possible the thickness of the occluding tissues, and the relative position of the bladder and rectum. It is surely, when doubt is present, better to dissect cautiously than to employ a trocar.

In 1859 I had the pleasure of performing, in consultation with Dr. West, a successful operation in a case of this kind which had given us much anxiety. The young lady was the daughter of a surgeon, himself only too well aware of the peculiar risks which at-

[1] British Medical Journal, July 23, 1859.
[2] Lond. Med. Gaz., vol. xxvii., p. 867.

[1] Principles and Practice of Gynæcology, p. 211.]

tached to the procedure. The vagina was about an inch and a half in depth, ending in a cul-de-sac. By the rectum a fluctuating and very tense tumor could be felt; but below this the bowel and the bladder were in almost close apposition, and the uniting structures very firm. The operation consisted in dissecting through the septum very cautiously, all the incisions being made from side to side, and the forefinger being kept in the wound to press back the bowel. At length the upper cavity of the vagina was reached, and a gush of thick tar-like fluid escaped. The os uteri was found closely united to the septum just above the opening. The incision was enlarged sufficiently to allow of the free escape of the fluid; but in the subsequent management of the case it was needful to employ sponge tents to keep it open. The patient recovered without ill symptoms, and afterwards menstruated regularly and without pain. Her death occurred, however, about six years afterwards, in connection with ovarian abscess. The canal had unfortunately been allowed to contract and was much narrowed.

The importance of attending to the opening for some weeks or even months after the operation is proved by the fact, that occasionally second operations have been requisite; and in one case, a patient who had survived the first died after the second.

In rare instances, if it be not thought practicable to reach the uterus from the vagina, puncture of the tumor per rectum and the establishment of a recto-uterine fistula may be desirable.

Cases in which the cervix uteri itself is the part which is obliterated occur every now and then, and require surgical relief on account of retained menses. Their management must be conducted on the same general principles as in obliteration of the upper part of the vagina, from which, indeed, it is often difficult to distinguish them.

III. Uterine Polypus.

Uterine polypus.—Hemorrhage is by far the most important sign of polypus uteri. Whenever the symptom of frequent and irregular discharges of blood from the vagina is present, and has lasted for some time and resisted ordinary treatment, the surgeon should on no account defer an examination. The speculum as well as the finger should be used. In such cases, if the conjecture has been correct, one of the following conditions may be found: (*a*) a sessile soft growth of small size, containing one or more mucous cysts,[1] consisting of enlarged uterine follicles and hypertrophied cellular tissue; (*b*) a pedunculated growth of small size (a bean to a nut), soft, vascular, and often multiple, consisting of pendulous mucous membrane, and analogous to the mucous polypus of the nares; (*c*) a growth of finer texture and larger size than the latter (a nut to an egg), more or less pedunculated, and made up of mucous membrane, with a large excess of cellular tissue; (*d*) a much firmer growth than any of the preceding, and usually a much larger one, either pedunculated or sessile, its attachment usually passing up into the interior of the womb—the common fibrous polypus (fig. 521). We will omit for the present all varieties of malignant disease, any of which may occasion hemorrhage, and in rare instances may even form growths of somewhat polypoid shape; and also those cases of fibrous tumors in which the growth is as yet embedded in the exterior walls, in which latter hemorrhage is also a most important sign.

Fig. 521.

Diagram showing two uterine fibroid tumors, one of which had passed downwards and become a polypus, the other being still encapsuled in the parietes.

Women of all ages are liable to the development of uterine polypi, but these growths are much more common during the period of menstrual activity than either in very early or in later life. In addition to the bleeding usually caused, we have in most cases leucorrhœal discharge, and more or less of bearing-down pain. The amount and frequency of the hemorrhage is often diminished when the polypus escapes from the grasp of the cervix; and it also, as a rule, lessens in proportion as the pedicle becomes longer and thinner.

In addition to the four varieties of sim-

[1] Now and then pedunculated cysts attached to the cervix uteri constitute polypi. Dr. Robert Lee has stated that one of the glandulæ Nabothi may be "converted into a cyst as large as a walnut, or even a hen's egg," and hanging by a slender peduncle. Medico-Chirurgical Trans., vol. xix., p. 127.

ple polypus above mentioned, we have in rare instances a form of tumor developed within the cavity of the uterus which is closely analogous to the recurrent fibroid in other parts. This tumor grows rapidly, assumes a polypoid form, attains a large size, and causes much bleeding. It can scarcely rank with true cancers, because it does not induce enlargements of the lymphatics or secondary deposits; but it differs from all the forms of simple polypus, in that it persistently grows again after removal. It, like the fibrous polypus, may have its attachment high up in the interior of the uterus. [The form of tumor here referred to is evidently that which is known at the present time as sarcoma of the uterus, first accurately described by Virchow.]

The surgical treatment of small polypi is usually sufficiently easy. They may be removed by scissors, by torsion, by ligature, or by the écraseur. In all cases in which the pedicle is long and thin, either to snip it through with scissors, or to twist it by means of forceps until it gives way, is the best plan. There is little or no danger of serious hemorrhage. The operation should always be performed with the part well exposed by means of the bivalve speculum. [The method of operating now generally preferred is to place the patient upon the left side and expose the parts by means of Sims's speculum.] In the case of the softer and more sessile forms it will be well to follow a practice strongly recommended by Dr. West, and touch the cut surface with the solid nitrate of silver. Unless the fear of bleeding renders the ligature the only safe plan, it is better to avoid it, as we escape by doing so the disagreeable consequence of a fetid mass remaining for some days in the vagina. [The ligature has given place to écrasement by the ordinary instrument or to the galvano-cautery. The use of either prevents hemorrhage and avoids decomposition and its consequences.]

The position of the attachment of the polypus is of great importance in deciding what method of treatment should be adopted. As a rule, it may be stated, however, that all the forms excepting the fibrous and recurrent fibroid are attached low down, either to one lip or just within the cervix. If the attachment is high in the cervix, it may become desirable to dilate the latter by the use of sponge tents.

[Polypi which have their attachments anywhere within the canal of the cervix, can be removed with safety; but clinical experience has shown that when they are situated above the os internum, their removal is attended with danger. Especially is this the case when it is necessary to dilate the cervix preliminary to the operation. On this account it is wise to defer the removal of intra-corporeal polypi until the tumor has dilated the cervix, if the condition of the patient will permit the delay. In the majority of cases dilatation of the cervix takes place without surgical interference, and the tumor is partially or wholly expelled from the uterus. If this does not occur after reasonable waiting, ergot should be used, in the hope of facilitating the expulsion.]

The fibrous (or, more correctly, musculo-fibroid) polypus is the most common, and as it is the only one (the very rare recurrent form excepted) which attains to a large size, it is the only one which for its safe removal requires any large amount of surgical ingenuity. The pathology of this form is now well understood, and it is generally recognized as consisting of an ordinary uterine fibroid growth, which has passed downwards, receiving an investment of mucous membrane. Dr. West has, however, directed attention to the fact that in some cases the fibrous tumor which has become polypoid is not separable from its investment, but is continuous with the uterine tissue. This is very exceptional. Although prone to cause profuse bleedings whilst *in situ*, neither the substance of a fibrous polypus nor its investing membrane contain any large vessels. No fact is more clearly proven by clinical experience than that these tumors, when cut into, or when detached by section of their pedicle, do not cause any dangerous amount of hemorrhage.

If a fibrous uterine tumor has become pedunculated and is the source of bleeding, it is the surgeon's duty to remove it. The procedures by which its removal may be effected are three: by ligature, by excision, or by the écraseur. A large majority of surgeons of the present day who have had much to do with these cases have recorded opinions adverse to the use of the ligature. If the pedicle be large, the ligature requires some days to cut its way through, and during that time the patient is exposed to the inconvenience and danger of a decomposing mass lodged in the vagina. This source of risk is not chimerical. A large fatality has attended the use of the ligature in the hands of all who have employed it much. Of twenty cases recorded by Dr. Robert Lee, nine ended fatally. This proportion is probably too high; but almost all surgeons will be able from individual experience to attest the fact that deaths do not unfrequently follow its use. Sir J. Y. Simpson, and Dr. M'Clintock, of Dublin, have both recorded facts and opinions adverse to the ligature. On the other hand, Dr. West states, that of twelve cases in which

he practised excision, all recovered without either hemorrhage or any untoward symptom; and Dupuytren, Velpeau, and Lisfranc have given similar testimony based on large collections of facts. I am not aware that any cases of fatal hemorrhage have been recorded. If, however, any fear should still be felt on this score, we have the écraseur, by which the gains of both methods may be combined, and the tumor may be taken away at the time without any risk of hemorrhage. It is, however, often difficult to apply. [The Hicks wire-rope écraseur or the galvanocautery wire loop are much more easily applied, and are therefore preferable.]

The operation of excision may be thus performed: The patient should be in the lithotomy position, and the tumor should be carefully drawn down by forceps or hooks into the external parts. Not unfrequently its pedicle may be brought almost to a level with the vulva, and then it is easily cut through with scissors.[1] If, however, it cannot be got so low, the scissors may still be quite safely used, the vagina being opened by a duck-billed spatula, and the forefinger of the left hand employed as a guide. Various forms of knives, mostly bent at the end, have been contrived for the special purpose of severing the pedicle in cases in which it is unusually high up. Sometimes, even after the tumor has been detached, much difficulty is encountered in removing it from the vagina. Dr. West mentions that he has been compelled to resort to midwifery-forceps for that purpose; and the same necessity has occurred to myself.

After the removal of a fibrous polypus the stump of its peduncle will wither, and there is no risk whatever of recurrence. As, however, fibrous tumors of the uterus are often multiple, it is very possible that a second may descend and become polypoid. The recurrent fibroid polypus is, like its allied growths in other parts of the body, very prompt and pertinacious in its return. It is, indeed, difficult, if not impossible, to effect its complete removal.

[The removal of a large polypus having a broad pedicle is most easily effected by écrasement and enucleation. As much of the tumor as can be easily reached is first removed by the écraseur; this gives room for further manipulation. The remaining portion is then seized with a vulsellum, and while traction is being made the fibrous mass is separated from its surroundings with a pair of blunt scissors or a small scoop. Among the cases which I have operated upon in this way, there were two in which the tumors extended through the uterine wall to the peritoneum, from which their bases were easily separated. Both recovered without an unfavorable symptom.]

But few examples of this form of growth are on record. In one treated by Dr. Atlee, of Philadelphia, between 1846 and 1851, four operations were performed, and with the result probably of greatly protracting the patient's life. In my own case two incomplete operations were performed within six months,

Fig. 522.

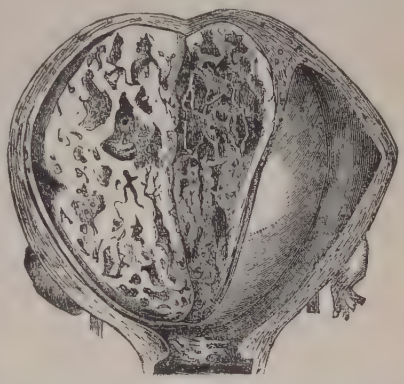


Diagram of a large soft-structured fibroid tumor developed in the uterine wall, and filling its cavity. (Compare with case referred to in the text, and figured in Path. Trans., vol. viii.)

and after each the patient was temporarily much benefited; she died, however, within three years of the first appearance of the growth.[1] A third case is recorded by Dr. West.[2] In it nine incomplete attempts at removal were made within about fifteen months; but although the tumor was greatly diminished, it was never wholly got away. Death took place nearly four years after the last, and more than six from the first appearance of the disease.[3] Dr. West, who gives an excellent *résumé* of our present knowledge of these cases, concludes respecting the treatment: "It may, however, be doubted whether our wiser course is not to let the disease alone; for while its complete removal seems impossible, its partial extirpa-

[1] Whenever it is needful to use scissors or forceps high up in the vagina, it is a convenient plan to protect their hinges, etc., by drawing over them a piece of sheet India-rubber, sown so as to form a tube of requisite tightness. In this way only the end of the blades need be left exposed, and there is no risk of folds of mucous membrane getting crushed in the joints or between the upper parts of the handles.

[1] Pathological Society's Transactions, vol. viii., p. 287, with plates showing the connections of the base of tumor to the uterine walls, and also its microscopic elements.

[2] See On Diseases of Women, p. 331 et seq.

[3] For account of the autopsy (by Mr. Callender) see Path. Trans., vol. ix., p. 327.

tion seems to be followed by an increased rapidity in its production." It may be added, that treatment by caustic injections into the substance of the tumor was tried, both in Dr. West's case and my own, but without good results.

[Uterine Fungosities.

Fungous growths developed on the endometrium have a general appearance not unlike that of nasal polypus, but they are usually more dense in structure. Their minute composition consists of hypertrophied elements of the mucous membrane, of dilated follicles, and enlarged blood-vessels, and of small portions of retained placenta which have maintained their vitality through attachment to the mucous membrane. These appear very much like ordinary fungosities, and they are usually treated of as such in text-books. They are frequently met with, at all ages from puberty up to the menopause. They are usually caused by long-continued hyperæmia of the uterus either from endometritis, subinvolution, or displacement. They are frequently associated with laceration of the cervix uteri and with submucous or interstitial fibroids.

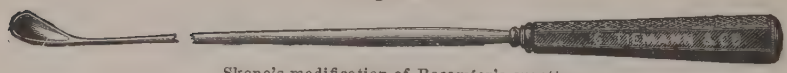
They occur after labor or abortion. According to my observations, they are especially liable to appear after frequent abortions caused by syphilis. The symptoms that characterize uterine fungosities, are menorrhagia and metrorrhagia. When either or both of these are persistent, and no other cause for them can be found, the presence of these growths should be suspected. In order to make a positive diagnosis, the patient should be examined with a Sims' speculum. The uterus being exposed and the cervix being fixed with a tenaculum, a small-sized scoop curette (to be described hereafter) should be introduced, and a portion of the growth should be removed for inspection. The appearance of the portion removed usually suggests malignant formations, but a microscopical examination of the specimen will settle the diagnosis.

Recamier first described this affection, and devised a method of treatment which is adopted without improvement by the highest authorities of the present time. The operation consists in scraping off the growths by means of Recamier's scoop curette (fig. 523). I have modified this instrument by having it made of flexible copper, with a handle, and small enough

Fig. 523.

Recamier's curette.

Fig. 524.



Skene's modification of Recamier's curette.

near the distal end to bend easily to any required curve (fig. 524). This instrument, while it is the same in principle as the original, is more easily adapted to the position of the uterus in relation to the vagina, and is a safer one in the hands of an inexperienced surgeon.

The operation is performed by placing the patient upon the left side, and exposing the uterus with Sims' speculum. The cervix is fixed by a tenaculum, and if the canal of the cervix is not already large enough to admit the curette, it should be enlarged by the uterine dilator. The instrument, curved to suit the position of the anterior wall of the uterus, is carried up to the fundus, and the whole anterior surface is carefully scraped. The two horns of the uterus are treated in the same manner. The curette is then curved towards its convex side to adapt it to the posterior wall of the uterus. This can be done without removing the instrument from the uterus, by withdrawing it until the scoop end is grasped in the os internum, and then depressing the handle so as to give the required bend. The growths are then shaved off from the posterior wall by passing the scoop from below upwards.

The operation is not painful, and hence the patient does not require an anæsthetic. As a rule no bad results follow, but in view of the possibility of inflammation ensuing, the patient should be kept quiet for a day or two. In some cases the menses are irregular for several months after the operation. There is also a tendency to recurrence of these growths, which necessitates, in some obstinate cases, frequent repetitions of the treatment; but as a rule the great majority of cases so treated end in recovery.

When these fungosities occur in subjects

having syphilis, and show a disposition to return, I have employed general mercurial treatment with apparent benefit.]

V. Fibrous Tumors of the Uterus, in Reference to Surgical Treatment.

It is chiefly in reference to the feasibility of attempting their removal by enucleation that fibrous tumors of the uterus become of interest to the surgeon. Although in many cases these tumors occasion but little inconvenience, and it is not at all uncommon to find them embedded in the uterine wall or pedunculated in the abdomen in cases in which their presence had never been suspected during life, yet in other instances they cause constant suffering, and imperil life. When we remember that they possess, in the majority of cases, but very slight connection either vascular or fibrous with the uterine structures, it is not to be wondered at, that attempts to enucleate and remove them should have been made. It is, however, chiefly within the last twenty years that this mode of dealing with them has been resorted to; and hitherto, with the exception of Sir J. Y. Simpson, Mr. Teale, and Mr. Baker Brown, but few British surgeons have been bold enough to attempt it. In France, Lisfranc, Jarjavay, Amussat, and Maisonneuve, and in America, Dr. Atlee, have advocated and practised it, the experience of the latter surgeon being indeed almost equal to that of all the others together. It is clear that attempts of this kind will vary much in their difficulty, and in the danger attaching to them, in proportion as the tumor may protrude into the uterine or vaginal cavity. The distinction between a "fibrous tumor" and a "fibrous polypus" depends solely upon the position of the growth in regard to the uterine walls; and in proportion as the tumor approaches the pedunculated or polypoid form, does its removal become easy. I shall enter at some length into the details of the enucleation process, not from any wish to advocate its claims to more frequent adoption, but because, since in some rare cases it is certainly advisable, it becomes desirable that all the light which can be derived from past experience should be made available. In the Medical Times and Gazette for August, 1857, I published, in a tabular form, all the cases of enucleation operations which I could then collect. They amounted to thirty-nine, the greater portion being either Continental or American. Upon the careful examination of these cases the following remarks are based.

First, let me remark that enucleation operations may be conveniently divided into two groups, since in some the intention has been to remove the tumor at the time, in others only to disturb its relations and inflict such injury upon its vitality as to induce its sloughing. By the latter method several operations, after intervals of time, are usually requisite. The former, of course, give us far more serious operations; but in the latter the process is a gradual one, and therefore the risk attending it is protracted over a much longer space of time. If the indications of the following table might be relied on, it would appear that the gross risk of the two modes is almost equal, and that, under either, about two-thirds of the cases end in recovery. We must examine the comparative merits of the two in a little more detail. Of the thirty-nine cases above alluded to as recorded in the Medical Times and Gazette, the following is a statistical summary:—

Method pursued.	Number.	Recovered.	Died.
Primary enucleations (completed) . . .	18	12	6
Ditto (attempted but not completed) . .	6	4	2
Enucleation by inducing gangrene . .	15	9	6

Primary enucleation. — Were certain cases in which enucleation by gangrene has been practised in Edinburgh added to the above table, that method would, it is believed, compare with still less advantage with the primary mode than it now does. But the truth is, that the cases in which it was pursued have been, as a rule, much more serious ones than those in the first list. In most the tumor was of a very large size, and either actually embedded in uterine tissue, or at any rate wholly enclosed within the cavity of the womb. Under the head of "Primary Enucleations," on the other hand, are included several cases in which the tumor was of small size (less than a pear), and several others in which it was already somewhat polypoid in shape, having been partially extruded by the spontaneous contractions of the organ. In these, of course, the danger to life would be comparatively but little. Of cases in which the tumor was of considerable size, intra-parietal, and not protruding either into the uterine cavity or the vagina, and in which, consequently, primary enucleation was undertaken under the most dangerous circumstances, we have thirteen; and of these seven ended in recovery, and six in death. In the less serious class, those, namely, in which either the tumor was small in size or already projected considerably, we have ten, out of which only two ended fatally; and of these two, in one the tumor, although projecting into the uterine cavity, was so

large that its removal had been found impracticable. It is evident, therefore, that in cases in which the two conditions of moderate size and of somewhat depending position are combined, the operation of primary removal by incisions and the use of the finger is attended by very little danger. In those in which the growth is of large size and completely imbedded, the chance of recovery after its removal is about equal to the risk of death. In the largest of all, those, for instance, in which the tumor approaches the size of an adult head, no surgeon would ever dream of primary enucleation. Among the causes of death, we find peritonitis and inflammation of the pelvic cellular tissue to be by far the most frequent. The hemorrhage, with one or two exceptions, is stated to have been insignificant; and very few appear to have died directly from the shock of the operation. Although in several the operators state that they felt themselves at the time in great risk of lacerating the peritoneal investment of the uterus, where spread over the surface of the tumor, yet that accident does not seem to have ever actually occurred. In only one case is it stated that any serious hemorrhage continued after the operation was concluded. Among the cases which recovered, in not a few the patients were very ill indeed, and had narrow escapes of death, either from peritonitis or exhaustion.

Mode of performing the operation.—Whosoever has either witnessed its performance, or read the detailed accounts given in some of the French narratives, will have no difficulty in admitting that the enucleation of a large embedded uterine tumor is an operation which will tax both the patience and skill of the operator. In not a few on record it occupied between two or three hours in its performance, and presented such obstacles that the operators were repeatedly on the point of relinquishing their task. The circumstance that these tumors not unfrequently occur in single women, in whom the vagina is narrow, often adds to the difficulties of the case. It is of course impossible to give rules which should be applicable to all; but the following memoranda are the result of much investigation, and a careful perusal of all that has been recorded, and will probably be useful to any one who may contemplate the performance of this operation for the first time.

1st. To have the tumor well depressed into the pelvis by an assistant. 2d. To let the first incisions be very free, and pass deeply into the tumor, thus not only completely dividing its capsule, but facilitating its bisection, should that afterwards be found requisite. This first incision should be made with a scalpel. In most cases it will be found convenient to pass the knife into the uterine cavity, and then, turning its edge on to the tumor, to cut downwards, and either forwards or backwards, according as the mass may occupy either the anterior or posterior wall. All experience goes to show that no important hemorrhage is to be feared from this incision, and if directed in the manner indicated, the whole substance of the tumor will intervene between the knife and the peritoneum. [When there is increasing danger from persistent hemorrhage, and it becomes necessary to operate before the cervix is dilated, bilateral incision of the cervix is advised. To effect this without hemorrhage, the thermo-cautery knife should be used. This method of operating has the advantage of saving the patient from loss of blood, and also of facilitating the first steps in the process of enucleation. The same means may be used to incise the capsule when the tumor is accessible, and when marked anæmia of the patient necessitates the avoidance of hemorrhage.] 3d. The capsule of the tumor having been opened, its separation should next be effected by means of the finger, or, if needful, by blunt-pointed curved scissors, the finger being used as a director. 4th. The surgeon should be provided for this part of the operation with a set of curved scissors of various sizes and shapes; one pair at least should be very long indeed. He should also have several pairs of strong and large vulsella, a spatula, a blunt hook, a scoop, and a pair of small midwifery forceps. In some cases the operator appears to have been baffled for want of vulsella of proper size and strength for securely holding the tumor. A strong whipcord ligature, and the various appliances for its use, should be in readiness in case of need. 5th. The grand object of the operator, after having separated the tumor from its cyst-wall sufficiently to allow of its lower part being seized, is to invert the uterus, and drag that viscus, together with the tumor, to the external parts. If this be accomplished, the main difficulty of the operation—that, namely, of working in a confined space—is overcome, and a speedy conclusion may be effected. To do this, a large vulsellum should be carefully planted in the mass, and traction, at first gentle, afterwards vigorous, must be exerted. The axes of the pelvis must of course be carefully observed, and the traction must be steady and not by jerks. As soon as practicable, a second vulsellum must be placed above the first, or if more convenient the midwifery forceps may be employed. 6th. After eversion has been accomplished, an examination with the finger in the rectum should be made, and the relative position of parts having been

duly ascertained, the remaining attachments of the tumor must be cautiously separated. The utmost care must be exercised not to cut into an inverted pouch of peritoneum. 7th. It is very possible, if the tumor be a large one, that it will be found convenient, before drawing it down, to cut away a portion or portions, and thus diminish its bulk. 8th. It is needless to remark, that throughout the utmost patience must be exercised, and as much gentleness as is consistent with the requisite degree of force. 9th. The operation complete, the everted uterus must be returned: if needful, a sponge plug should be introduced, and a full dose of opium should be given. 10th. The use of ice, of the ergot, and of diffusible stimuli, must be resorted to, or not, according as circumstances may require.

[After the removal of the tumor, the cavity of the uterus should be thoroughly washed with carbolized water, or such other disenfectant as the surgeon may choose, and injections of the same should be employed daily until all discharge has ceased.

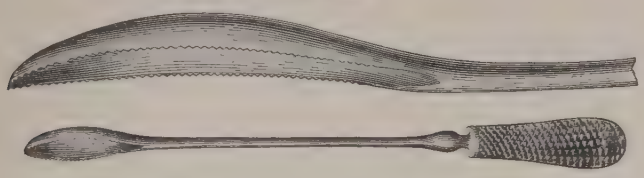
Dr. T. G. Thomas has devised an operation which I prefer to all other methods of enucleation. His description of the operation and its advantages are as follows:—

"This method consists in seizing the tumor at its most dependent and accessible point with strong vulsellum forceps, passing up along its sides the spoon-saw or serrated scoop (fig. 525), and, by a gentle pendulum motion from side to side, sawing through the attachments of the tumor and freeing it entirely from its connection with the uterus.

"This instrument consists of a steel spoon with a strong handle, twelve or thirteen inches long. The spoon itself is slightly convex upon its outer and concave upon its inner surface, while its borders are serrated. The saw teeth are blunt, and not slanted in either direction, but perpendicular. The outer convex surface protects the uterine wall entirely, while the inner and concave causes the instrument to hug the tumor and run along its surface, as it cuts its way laterally and upwards.

"The advantages, which experience teaches me attach to this instrument, are the following: 1st, the attachments of the tumor are

Fig. 525.



Thomas's spoon saw.

separated by a saw, which greatly limits hemorrhage: 2d, the shape of the spoon, convex without and concave within, causes it to follow of itself the contour of the tumor, unless this be very lobulated, and protect the enveloping uterine tissues from injury; 3d, the highest points of attachment of the tumor are as readily reached as the lowest, the freed growth descending under traction as the saw severs its adhesions in successive sweeps around it; 4th, the saw action gives to the process of separation, whether the growth be interstitial or submucous, sessile or pedunculated, rapidity and certainty; and 5th, and last, though by no means least, the nature of the spoon-saw secures separation of a growth at the highest point of its attachment, leaving no peduncle to decompose."]

Enucleation by inducing gangrene.—This method, if we count those in which primary enucleation was attempted, but could not be effected, and include also a few others not yet on record, has been performed in about 27 cases; out of these there have been about 13 deaths, 10 recoveries, and 4 incomplete cases in which either it was known that the whole of the tumor had not come away, or there was a return so soon as to render it highly probable that some part had been left behind. Almost all these were cases in which the tumor was of very large size, and in several the operation was undertaken on account of immediate urgency, and after the patient had been reduced to the very lowest stage by hemorrhage. Thus it appears probable that of cases of this class somewhat more than one-half may be expected to come safely through the risks incident to the procedure, and rather less than half to result in complete cures. It must be borne in mind that a large majority—indeed, almost the whole—were out of all possibility of treatment by the primary method. This plan has the recommendation of being an attempt to imitate nature. Although confessedly very infrequent, yet cases have occurred in which fibrous tumors of the womb have sloughed, and been extruded from their bed without the assistance of the surgeon.[2]

[1] Thomas on the Diseases of Women, p. 539.]

[2] For an interesting example of this, see Mr. Grimsdale's paper in the Liverpool Me-

A far more common event than this is for them to become pedunculated, and assume the polypoid form, without wholly losing their connections to the uterus. Although but few facts exist on which to ground a positive opinion, yet judging from those which have fallen under my notice, I suspect that the fatality of the cases in which spontaneous extrusion has occurred has been little less than that of those in which it has been induced artificially. The process is one always attended with much constitutional irritation. Although no single operation is required in itself involving much risk, yet with a large sloughing mass in such an important position, with fetid discharges continuing for several weeks, the patient is kept for a considerable time in constant danger of the development of some fatal complication in the form of pyæmia, peritonitis, or a low type of inflammation of some of the internal viscera. Repeated, if not almost daily, manipulations are needed, and the increased risk of some contagion, either of erysipelas or pyæmia, being thus conveyed by the surgeon, must not be lost sight of, especially if the patient be an inmate of a hospital.

Then, again, it must be borne in mind that the patient has been reduced by long continued hemorrhage, and that in all probability her vital organs are already, to some extent, in a state of fatty degeneration; a condition which, under the evil influence of profuse suppuration, is not unlikely to become rapidly advanced to a degree incompatible with continuance of function. These kinds of risks render the operation one which will always be attended with much danger, and it must be admitted that it is one which ought never to be performed in a hospital ward. A healthy locality, and privacy in a large, well-ventilated room, with the undivided attentions of a nurse, should be regarded as essential conditions. With these, and with most persevering attention to all minutiæ of the medical and dietetic management of the patient, it may, perhaps, be reasonably expected that the mortality, even in severe cases, might not exceed a third; but there are certainly, thus far, no grounds for expecting better success than this.

With regard to the plan of operating, it would appear that the knife possesses great advantages over escharotics. The object is as much as possible to separate the adhesions of the tumor from its cyst, and to thus cut off its vascular supply. Now the effect of the application of escharotics is well known to be to induce the union of subjacent parts, and of this the surgeon not unfrequently avails himself; as in the instance of abscess in the liver, requiring to be opened externally. The dread of hemorrhage from the incisions has been proved to be for the most part a chimera, and the prevention of this is, as far as we can see, the only shadow of an advantage which can be claimed for the escharotic plan. By means of a free incision, the surgeon may not only divide the capsule thoroughly, but damage the tumor itself, and facilitate the employment of the finger in accomplishing the separation of the cyst-wall to as great an extent as practicable. The usefulness of ergot, after a free opening has been made, and the certainty of its action in promoting the expulsion of the tumor, is a point on which all observers agree. Whether or not an attempt should be made to accomplish the enucleation of the sloughing mass, by the hand, within a week or two of the commencement of the treatment, or whether it should rather be left to disintegrate and come away in fragments, is a point which the circumstances of the particular case must decide. Dr. Atlee's experience seems to be, that the tumor may be left to disintegrate, with very good confidence (provided it has been well exposed and freely cut into) that such results will ensue; and some facts which have fallen under the writer's observation lead him to give full credence to this *à priori* improbable statement. The vitality of many uterine fibroids appears to be very small indeed, and comparatively little interference will often suffice to insure their death; whilst the manner in which large tumors, when they have once become sloughy, will, as it were, melt away, is quite astonishing. [This method of treating fibroids has been falling into disuse of late years, while primary enucleation has been gaining favor with surgeons.]

What events may be expected when fibrous tumors are not interfered with? The determination of the feasibility of the enucleation treatment does not rest solely on an accurate estimate of the amount of risk which inevitably attends it. We must consider the other alternatives which are offered us. And here, in truth, is by far the greatest difficulty of the question. If these tumors were always fatal within a short space of time, no one

dico-Chirurgical Journal, No. I. I do not know where to turn for the record of an instance of *spontaneous piecemeal* disintegration, such as occurs in the cases surgically treated. One such, however, happened in St. Bartholomew's about ten years ago, the patient being one of the ward nurses, and its particulars were mentioned to me, in conversation, by Sir J. Paget. The woman recovered; but Dr. West has informed me that subsequently another tumor protruded, as a polypus, was removed by ligature, and that death from pyæmia followed.

would hesitate to recommend a procedure that offers a fair chance of a complete cure in a proportion of about two-thirds. But we know, on the other hand, that they are by no means of infrequent occurrence, and often cause their possessors exceedingly little inconvenience. In cases, too, in which during one stage, and that often a protracted one, repeated and exhausting hemorrhages have occurred, we know that not infrequently the tumor will either alter its position, diminish in size, or undergo such modification in its relations that the troublesome symptoms may cease to occur, and the patient be restored to health. On this point we will quote only the confirmatory testimony of Lisfranc, which is the more valuable because it comes from an ultra-partisan of the operation. After speaking of temporary abatement of symptoms, that surgeon writes: "Il est des personnes plus heureuses; après avoir éprouvé pendant quelques années des douleurs violentes, des pesanteurs fort incommodes, des pertes très-abondantes, beaucoup de troubles dans les fonctions digestives, etc., elles voient ces phénomènes morbides se dissiper; l'embonpoint renaît et même quelquefois la fraîcheur: il existe seulement un peu de flueurs blanches, une légère pesanteur et quelques petites douleurs dans les reins; j'en soigne plusieurs qui, portant des matrices énormes et fortement bosselées, fournissent depuis dix ou douze ans leur carrière avec les faibles inconvénients que j'ai indiqués; elles semblent promettre de la poursuivre longtemps et peut-être même, à l'aide des moyens hygiéniques et de quelques soins thérapeutiques, comme si l'utérus était à l'état sain." Clin. Chir. de la Pitié, vol. iii., p. 16. Researches

Fig. 526.

Diagram showing a uterine fibroid encapsuled in the fundus of the organ, and likely to grow upwards into the abdomen.

in the pathological theatres show us what these changes are, the effects of which we have noticed in our patients. Uterine tumors are often found contracted and to a large extent calcified; or they may be lodged in the outer part of the uterus, or even pedunculated into the peritoneal cavity. We might also mention, under the possible events which may obviate the necessity of an operation, that spontaneous enucleation may occur; but, as we have seen above that the risks attending this process are probably as great as when the surgeon interferes, it need not claim much attention. Thus, then, there are probably but very few cases in which the conscientious surgeon could say to his patient that there was no chance of recovery without an operation. Still, however, that numerous deaths from these tumors do occur is undoubted;[1] and in certain cases the amount of reasonable hope is, it will generally be admitted, very small indeed. While, therefore, the indiscriminate performance of these operations would be exceedingly unwise and wrong, yet we cannot but think that the reverse is the case under conditions of urgency. It happens very fortunately that tumors which cause serious symptoms are usually those most easily accessible. The proximity of the tumor to the mucous membrane of the uterus or vagina, but especially to that of the uterus, appears to be the main determining cause of hemorrhage, and just in proportion as the mass bulges inwards is of course its suitability for enucleation. Tumors of very large size have, on the contrary, usually risen well out of the pelvis, and the symptoms attending them are often comparatively insignificant.

Conclusions.—I state the following as conclusions, not in any dogmatic or positive sense of the term; they are the impressions arrived at after much careful study of the subject, but further experience may very likely modify some of them:—

1. That surgical interference with interstitial fibrous tumors of the uterus is always attended with very considerable risk, and ought not to be practised except under circumstances of urgency, or when the position of the growth is peculiarly tempting.

2. That when the tumor is not of very large size, and is already partially extruded, the operation is rendered comparatively devoid of danger, and ought to be performed at once.

3. That when the tumor is as yet wholly embedded, and even when of large size, the enucleation treatment is yet warrantable, if the patient's life be threatened by hemorrhage.

[1] An instructive and warning case of death from a fibrous tumor, which was in slow process of spontaneous extrusion, is given by Mr. Grimsdale in the paper already referred to. The tumor was found after death to have been well suited for removal by operation. Many such cases might doubtless be collected. I refer to Mr. Grimsdale's paper with much pleasure, on account of the ability and candor which characterize it. Those who contemplate the performance of operations of this kind will do well to refer to it, as also to the detailed descriptions which have been given by French surgeons.

4. That primary enucleation, where at all easily practicable, is much preferable to the secondary method.

5. That where the tumor is very large, or where found after the incisions to be firmly united to its capsule, the secondary plan should be preferred.

6. That whichever plan it is intended to adopt, the first incision should, excepting under unusual circumstances, be made from within the cavity of the cervix, and should be as free as possible.

7. That the danger of hemorrhage from this incision is very slight indeed.

8. That as much should be done as practicable at the first operation in freeing the tumor from its cyst. Thus, if the adhesions be found more loose than had been expected, a primary enucleation may be completed where the slower plan had been proposed.

9. That the after-treatment, in cases of primary enucleation, should consist in warding off the shock by opiates, in sustaining the strength, and in the free use of stimuli and nutritious diet.

10. That in cases of secondary enucleation the ergot of rye should be administered, so as to keep up vigorous uterine action; and that the greatest attention should be paid to sustaining the patient's strength, and to the removal of discharge and shreds of slough, as fast as formed.

11. That in cases of great exhaustion and threatened pelvic inflammation, the internal use of turpentine is of great value.

12. That in cases of secondary enucleation the surgeon need not be anxious about the removal of the tumor *en masse*, but may confidently expect that, if it have taken on a sloughy state in its lower part, the death and piecemeal disintegration of the whole will follow.

13. That the "recurrent fibroid" tumors slough away yet more readily after interference than the true fibrous ones, although liable to return after a short interval.

14. That after a successful enucleation-procedure, complete, though gradual, restoration to good health may be expected.

[The treatment of fibroids described above, applies only to such tumors as can be reached through the cavity of the uterus,—the submucous and the interstitial. The sub-peritoneal fibroids are less amenable to surgical treatment, and it is only when such tumors positively endanger life that surgical interference is justifiable. The method of treating these are as follows: Excision by laparotomy, adapted to pedunculated tumors; ablation of the uterus, indicated when the attachment of the tumor to the uterus is such as to render the separation of the two impossible; and removal of the ovaries, oöphorectomy, Battey's operation, for the purpose of inducing the menopause and thereby preventing the further growth of the tumor, a result which is sometimes attained.

Excision by laparotomy is performed in the same way as ovariotomy, and hence need not be described here.

Several methods of performing ablation of the uterus have been described. Dr. Thomas's operation appears to me to be preferable. The following is his own description of the procedure.[1]

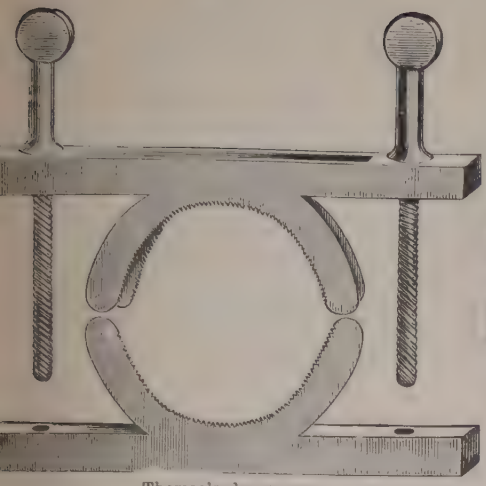
"The abdominal walls are incised as for ovariotomy, and all cystic formations emptied by the trocar and canula. The lowest portion of the tumor is then manipulated so that a strong cord, a piece of cod-line for example, is passed under it. By this the pelvic extremity of the tumor is lifted, so that one limb of the clamp (figs. 527 and 528, p. 999), which measures nine and a half inches in length, can be passed under it. The second limb of the clamp is then screwed to the first, the tumor cut through, the severed end of it drawn down by the vulsella, and the entrance of blood to the peritoneal cavity being prevented by stuffing napkins under and around the bleeding surface, the mass is diminished in size by the knife, and removed as rapidly as possible. The pedicle is then examined, and if it be found practicable a second clamp is placed lower down, the first removed, and additional tissue cut away above the lower one. The clamp is kept in place during the progress of the case as after ovariotomy.

"Should this manœuvre be found to be impossible from the great bulk of the lower segment of the tumor, the incision is prolonged to such an extent that the tumor can be delivered with a certain degree of force. Two assistants then lift it as high in the air as possible, and the attachment of the bladder to the tumor being examined by the catheter, the former is detached from the latter, if this be found necessary. As near to the vaginal junction as it can be placed, the large clamp is then applied and screwed so firmly as to control hemorrhage.

"By this means the portion of the tumor which is to be used as a pedicle is compressed, and, as far as possible, diminished in bulk. The tumor, and as much of the uterus as is above the clamp, is now cut off. The clamp is thus far used as the main hemostatic agent, but it is not to be thus employed permanently. Three or four steel knitting needles are now passed through the tissue just above the clamp, at right angles, so as to support the part after the clamp is loosened. Then by large cautery irons the tissue above clamp and needles is thoroughly charred. This is the permanent hemostatic power upon which dependence is placed, and to render it reliable the whole inch of pedicle above the clamp should be completely charred. The clamp is now loosened, the ordinary antiseptic dressing applied, and the patient put to bed and closely watched for evidences of hemorrhage or shock. The first should be met by tight-

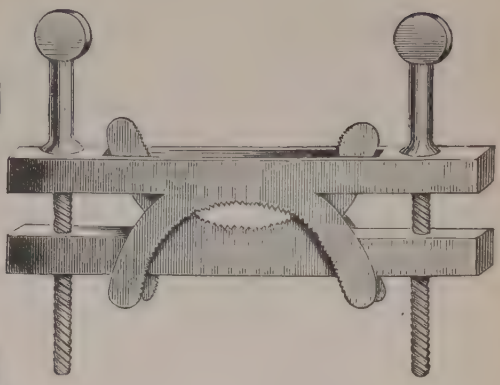
[1 See Thomas on the Diseases of Women, p. 549.]

Fig. 527.



Thomas's clamp open.

Fig. 528.



Thomas's clamp closed.

ening the screws of the clamp, the second by hypodermic injections of morphia, brandy, and ether, and by warmth to the entire body, especially the soles of the feet and palms of the hands."

The third method of treatment, removal of the ovaries is given under oöphorectomy, p. 1024.]

VI. Cancer of the Uterus in reference to Surgical Treatment.

Malignant disease of the uterus rarely presents itself to our notice in a stage permitting of surgical cure. Including in that term the so-called cauliflower excrescence, the epithelial cancer, and the medullary cancer, the remark still applies to all, that they have usually advanced too widely when the surgeon is first consulted, to allow of the satisfactory employment either of the knife or caustics.[1] In a vast majority of cases, all these forms of morbid growth begin at or very near to the os uteri; and if discovered early, would probably admit of removal, in many instances, with benefit more or less lasting. In all, however, the ulceration extends rapidly, and the patient does not submit to an examination until already the vaginal tissues have become involved, or the cervix has been deeply attacked. If the disease have thus widely extended, if it have left the lips of the uterus laterally, or if it have passed upwards and induced thickening of adjacent structures, then the operation of excision is attended by great danger, and affords but little chance of benefit. Hence it follows that suitable cases for operation are very rare.

It is not by any means an easy matter in many cases to make a confident differential diagnosis between a simple or venereal ulceration of the os uteri and one of a malignant nature in an early stage. The tendency of the latter to bleed, its warty and thickened edges, and fetid discharge, are the chief symptoms on which to rely. The surgeon must notice especially whether there be any tendency to new growth, and, if practicable, a small portion of the edge should be removed for microscopic examination. Pain, if severe, is a very suspicious sign. That old syphilitic ulcers may occasionally assume a cancerous action, there is good reason for believing. If doubt be felt, it should, if possible be removed at once, either by consultation with others, or by resort to the microscope; for if the disease be in a stage permitting of removal, it should on no account be allowed further time for extension.

With regard to the diagnosis from each other of the different varieties of malignant disease met with in this locality, no practical benefit can be got from its detailed consideration here. With respect to them all, the question of surgical importance is more as to extent than kind. All, if limited to the lips of the uterus, and if the latter organ be unenlarged and quite movable, should be either removed by operation or destroyed by caustics. If

[1] "Though for the past twelve years I have been constantly looking out for cases suitable for it, but one instance has come under my observation, in which my surgical colleagues have considered it justifiable, and two or three more in which, in my own opinion, it might have been attempted." Dr. West's Lectures, p. 413.

neither of these procedures are appropriate, the only resource left is palliative treatment—the mitigation of pain; the restraining of hemorrhages, and the lessening of discharge and fetor. Opium, rest in the recumbent posture, and the use of detergent injections (arsenic, Condy's fluid, chloride of zinc, and the like) are the means by which these indications are to be attained. The prognosis of malignant disease of the uterus, despite all that can be done by art to diminish the sufferings which lead on to the inevitable result, is most gloomy. The fact that a most painful and protracted death is the other alternative ought certainly to be allowed its due weight in inciting us to energy in the treatment of any cases which come under observation in an early stage, and may even justify resort to measures not by any means free from immediate risk.

I shall probably be excused for not entering here into any examination of the operation for extirpation of the whole uterus when affected by cancer. That, excepting in very rare instances of complete procidentia, it is not justifiable, is admitted by all. Dr. West, who has carefully collected the statistics concerning it, informs us that of a total "of 25 cases, 22 terminated fatally in consequence of the operation," and but 3 recovered. Of the three latter, "two months, four months, and one year were the periods during which the patients respectively survived."

Excision of cancerous ulcers affecting the lips of the uterus (or amputation through its cervix) is an operation of a very different character, and in well-selected cases not attended by any large amount of risk. Its introduction dates from the earliest years of the present century, when it was largely employed by Osiander, of Göttingen, and subsequently by Lisfranc, of Paris. Unfortunately, for reasons which we need not state, the large statistics brought forward by the latter surgeon are utterly without value. In this country it has not been very largely adopted, although many surgeons have performed it in isolated cases. Sir James Y. Simpson has probably had the largest experience of any British surgeon respecting it.

Mode of performance. — The patient should be placed in the lithotomy position, and the thighs well separated. The vagina being opened by the duck-billed spatula—or, if requisite, by a bivalve speculum—the cervix should be securely seized by long toothed-forceps or Museux hooks, and steadily but gently dragged downwards. At this stage it is a good precaution to transfix it latterly, above where it is intended to cut, by a needle armed with a wire ligature, the latter to be retained. The uterus having been brought as low as possible, the incisions are to be commenced below, at a suitable distance from the diseased structures, and carried from behind inwards and upwards; then a similar incision is made in front, and carried inwards and backwards so as to cut out a conical portion. In this incision either scissors or knife may be employed; if the latter, it should have a rounded point. After the section, by means of the wire previously inserted, the stump may be still held in view, both to permit of examination as to whether the disease has been completely removed, and of the application of escharotics, should the hemorrhage make them desirable. The advantage of beginning at the lowest part is, that the blood does not conceal the surface where the next incisions are to be made. It is one of those operations in which the plan of constant irrigation during its performance may be adopted with advantage. The actual cautery and the perchloride of iron ought to be at hand, in case their application may be required. As hemorrhage may chance to recur some hours afterwards, it is desirable to retain hold of the stump by leaving the wire in, or the latter may be made use of to tie a compress of lint over the bleeding surface.

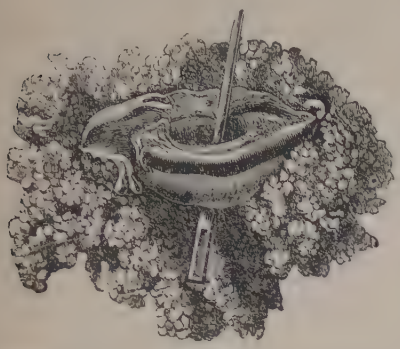
With the precaution above described the operation of excision by cutting instruments is probably safer and preferable every way to that by the écraseur. With the latter instrument the surgeon is not able to adapt his line of incision accurately; the chain must pass horizontally across the entire cervix, and, in order to be sufficiently above the disease at one part, it may be needful to take much more than is necessary at the opposite side. This would be of minor importance if it did not involve more or less risk of including a portion of the peritoneal pouches, which have been drawn down by the back and front parts of the cervix.[1] It is impracticable with the écraseur to remove a conical portion, as advised above; and lastly, although this instrument obviates to a great extent the danger from hemorrhage, it probably increases those from peritonitis and pyæmia. It is for cases of long cervix that the écraseur is especially adapted, and precisely in the same is direct excision easy and safe.[2]

[1] This risk is not imaginary. I am acquainted with a case in which a considerable portion of the peritoneum was thus removed. Others are also on record. See Simpson's Lectures in the Medical Times and Gazette, vol. xviii., p. 105, and Dr. West, op. cit., p. 416.

[2] If the écraseur be used, an instrument

After the amputation of the cervix uteri, whether by scissors or écraseur, the patient should be carefully and unremittingly watched for twenty-four hours. In addition to the risk that bleeding may occur, it is possible that a peculiar form of collapse (abdominal collapse of Dr. Barnes) may supervene. Simpson records two such cases, one of which proved immediately fatal, there having been no hemorrhage or other cause adequate to explain it.

Fig. 529.



Copied from Sir James Y. Simpson's Obstetric Works, vol. i., p. 164. The wood-cut represents a cauliflower excrescence excised in the case referred to in the text.

For reasons already hinted at, it is almost impossible to obtain any trustworthy data, either as to the immediate risks of the operation or the average duration of life in successful cases after it. Simpson records in detail one case in which he excised a large epithelial cancer (cauliflower excrescence), and the woman at the date of his lecture (eighteen years after the operation), was still in good health, having borne several children in the interval. He seems to be, on the whole, very favorably impressed as to the value of the operation; but he abstains from furnishing any numerical data as to the results he has obtained.[1] With the exception of two or three cases in Guy's Hospital, the operation has not, I believe, been performed of late years in any of our larger London hospitals. The Guy's cases, were, I believe, all successful, but productive only of temporary benefit.

Fig. 530.

Nodule of cancer in the scar left by an excision of the os uteri six months previously. The wood-cut shows the exact size of the portion removed at the second operation. The probe is passed up the canal of the cervix. From a case recorded by the writer in the Path. Trans., vol. viii., p. 253. [See also fig. 531.]

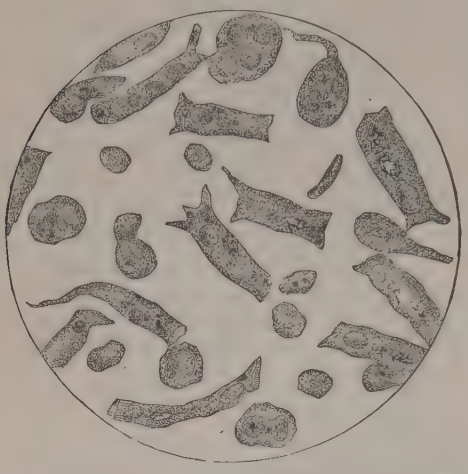
If the case be one in which the surgeon has any choice as to performance of excision, he will probably do well to prefer it to the use of escharotics. There are certain cases, however, in which the disease extends too deeply for a safe excision, where it may yet be fair to employ the former. The best for the purpose is probably the dried sulphate of zinc, as advised by Sir James Y. Simpson. It may be applied either in powder, by aid of a speculum, or made up into a pessary by means of ointment. Some carbonate of soda, in the form of a pessary, should be introduced into the vagina, to neutralize the zinc in case it should run. The potassa fusa is not manageable; but the chloride of zinc may, with care, be conveniently used. The actual cautery is, however, perhaps as efficient, as free from risk, and as little painful as any, especially when heated by the aid of galvanism.

with a curved end will be found more convenient than a straight one. A strand of twisted wire, as recommended by Simpson, will be better than a chain.

[1] The following extracts from his lecture are of much interest: "I never saw a case which proved fatal by bleeding, or even one where hemorrhage occurred in any alarming degree." "Let me lastly observe, that some patients, but not very many, have died of peritonitis, or that form of surgical fever," etc.

In many cases in which escharotics have not effected a cure, the patient has yet been fully compensated for the pain incurred, by the temporary alleviation of symptoms which resulted.

Fig. 531.



Cell structures from the nodule, showing altered forms of columnar and ciliated epithelium.

[The great object in the surgical treatment of cancerous disease of the uterus, is the removal or destruction of all of the abnormal tissue by means which will cause the least possible hemorrhage. The use of the galvano- or thermo-cautery fulfils these indications.

When the disease is limited to the cervix, the wire of the galvano-cautery is passed around the cervix as high up as possible, and the parts are amputated by slowly narrowing the loop of the heated wire.

If the disease has extended above the reach of this method of operating, the involved tissue should be rapidly removed by Simon's scoop, or Sims' curette. To arrest the hemorrhage and destroy any abnormal tissue which may have escaped the curette, the parts should be thoroughly cauterized by the thermo-cautery. The hemorrhage which occurs in this method of operating is sometimes quite free, but usually not dangerous, if the curette is used boldly and rapidly. In case the bleeding should interfere with the cauterization, a tampon should be introduced and left in place for twenty-four hours or more, when it can be removed and the parts cauterized.]

VII. Malignant Disease of the External Genitals.

The chief form of malignant disease by which the external genitals of the female are attacked is epithelial cancer. With the epithelial disease, there may in some cases be a certain amount of melanotic growth interspersed, or the disease may even begin in a mole, and be chiefly of the latter character. In females of middle age epithelial cancer of the labia, or adjacent parts, is by no means infrequent. The disease presents the same characters as in other parts. An irregular, undermined indurated edge, an unhealthy gray surface, and a tendency to the production of warty granulations, are its chief features. It is a most formidable disease. Absorption from these parts is usually very rapid: the glands in the groin become contaminated with startling rapidity; and the surgeon's function is then for the most part restricted to attempts at alleviation. In all the cases with the subsequent history of which I am acquainted, the result has been a speedy recurrence. In two of my own it was needful to remove also diseased glands from the groin.

Like epithelial cancer of the penis, scrotum, etc., in the male, it is chiefly met with in middle-aged or elderly persons, but may occasionally be found in younger women. Not unfrequently when it occurs to young adults, it attacks a sore which was in the first instance venereal. This fact must be kept in mind in practice, or an error in diagnosis may result. The one point in respect to the hopeful treatment of epithelial cancer is its early recognition.

Considerable differences are observed in different cases of cancer of the female genitals. In some the course of the disease is very rapid, in others much slower. I believe it will usually be noticed that when the ulcer began on the mucous surface it has been rapid in progress, and that when in the skin it has been more slow.

Although, as above stated, it is extremely prone to recur after excision, yet, as we possess no other remedy, there can be no doubt that, wherever practicable, the diseased part should be freely removed, or destroyed by caustic. In most cases the knife is probably preferable. If the inguinal glands are at all enlarged, such as are so should be removed also. These operations are rarely dangerous to life, and usually the patient's sufferings are wholly relieved for the time; often a few months of enjoyable life are obtained before the disease recurs. Since, therefore, in almost all instances they give relief for a longer or shorter period, while there is always a chance that a cure may be obtained, it is without doubt the surgeon's duty to give his patient the benefit offered whenever practicable. If the dis-

ease recur, a second period of health and freedom from suffering may be obtained by a second use of the knife. Whether the operation be a primary or a secondary one, it is impossible to exaggerate the importance of doing it early. It is only in the early cases that there is any chance of a permanent cure.

Respecting the Rodent Ulcer, little need here be said. It is very rarely met with on the female genitals. I think I have seen one undoubted example of it. It is distinguished from epithelial cancer by the absence of warty growth, by its slow progress, and by its never causing the lymphatic glands to enlarge. It should always be excised when practicable. The diagnosis will usually rest between it and sores of tertiary syphilitic origin.

VIII. Non-malignant Diseases of the External Genitals.

The diseases of an innocent nature to which the external genitals of the female are liable will chiefly find place in connection with other subjects. Thus the induration and enlargement of the labia, clitoris, etc., are most frequently forms of elephantiasis consequent on venereal affections. It may be convenient, however, to remark here, respecting the removal of these enlargements, that they may for the most part be undertaken with perfect safety. Hypertrophies of the labia commence usually in inflammatory œdema, produced by the irritation of gonorrhœal discharge, or of mucous tubercles; but when they have advanced to a certain extent, they tend to increase, in consequence of the mechanical impediments to a normal state of circulation presented by their pendent position, and without any reference to their original cause. It is therefore desirable that they should be removed early. When very large, the risk of very profuse hemorrhage is considerable. The bleeding is usually from a multitude of small vessels, not from any single one of considerable size. A good precaution against hemorrhage is to transfix the base of the pendulous mass by means of hare-lip pins before using the knife. Over these pins twisted ligatures may be applied, so as tightly to compress the divided structures and arrest all bleeding. Of course all vessels that can be tied separately should be secured previously to the application of the twisted sutures. On several occasions I have found the latter the only means by which the continued draining from small vessels could be stopped.

These tumors consist only of hypertrophied cutaneous structures, and may be developed to a very large size, if not removed in anticipation. They may involve one or both labia, the clitoris, or any part of the immediately adjacent integument. It is sometimes needful to bear in mind that their subjects have often also suffered from constitutional syphilis, since, in the after-treatment of the wound, specific remedies may become necessary.

Cystic tumors may be met with occasionally in the subcutaneous tissues of the female genitals. The most common are those formed in connection with the Cowperian glands. They are found to be about an inch or an inch and a half within the vulva, and placed a little below the middle of one or other side of the vagina. They are usually somewhat movable, and non-adherent to the mucous membrane; often very tender to the touch; and rarely larger than a chestnut. When opened, a glairy mucus escapes, often of fetid odor. Their mucous contents may be mixed in greater or less degree with inflammatory products; and sometimes acute inflammation has occurred, and dirty grumous pus, of most fetid smell, is the product. For all these conditions the simple measure of treatment is to lay them freely open, and to introduce lint, to prevent premature closure of the orifice. They are more common in young women than in those of more advanced age, and are not unfrequently met with soon after marriage.

In rare instances cystic tumors of much larger size than those developed from inflammation of Cowper's gland occur beneath the labia. These sometimes possess a smooth lining membrane, which it is desirable to dissect cleanly out, in order to prevent refilling. Their contents are usually glairy, indicating that the starting-point was from a follicle or mucous gland. There is almost always the history of long duration. An entire absence of inflammatory irritation has usually been the reason for their being allowed to attain to an inconvenient size before surgical advice has been sought. In undertaking the removal of these cysts, the surgeon must always be prepared for free hemorrhage, owing to the highly vascular endowments of the parts.

[Pudendal Hematocele.

The interruption of the venous circulation in the lower portion of the body occurring in pregnancy predisposes to hematocele. The vessels become distended, and their walls attenuated, so that they are liable to rupture during labor. For these reasons hematocele occurs most frequently as a complication incident to

child-bearing, and its management therefore falls to the lot of the obstetrician. For a full discussion of this subject the reader is referred to the work of Prof. Fordyce Barker on puerperal diseases.

Apart from pregnancy and parturition, pudendal hematocele may be caused by injuries, and its management then devolves upon the surgeon. When a blood-vessel in the labia or in the lower portion of the vagina is ruptured from any cause, such as a direct blow, the blood is poured out into the areolar tissue, which yields so readily that but little pressure is made upon the bleeding vessels, and hence the hemorrhage is usually extensive. In slight cases recovery may take place by absorption of the transuded blood, but in well-marked cases the accumulation of blood is so great as to arrest the circulation in the parts involved, and sloughing may follow. If this does not occur, suppuration takes place, owing to the interrupted nutrition caused by the presence of the coagulated blood. Extensive suppuration may be followed by septicæmia, a condition which I have known to end fatally in one instance.

The symptoms are pain in the part affected, sudden swelling, and after a time discoloration. If inflammation and suppuration take place, the symptoms characteristic of these conditions are developed.

If a case comes under the surgeon's observation while hemorrhage is still going on in the areolar tissue, efforts should be made to arrest the flow by the application of ice or by pressure. If this treatment is ineffectual, or if the patient is not seen until the bleeding has ceased and the blood has coagulated, the most effectual treatment is to make a free incision, evacuate the accumulated blood, and treat the cut as an ordinary wound. I much prefer to make the incision with the thermo-cautery. By this means further hemorrhage is avoided. In a case recently so treated the bleeding began again—as often happens—after making the incision and removing the clot. The largest bleeding vessel was found and ligated, and a number of points from which there was oozing were touched with the cautery, and all hemorrhage was completely arrested. Drainage was provided for, and the ordinary antiseptic dressing employed. The patient made a rapid recovery.

If the thermo-cautery is not at hand, the incision can be made with a scalpel, and the hemorrhage controlled by means of the ordinary styptics. When the clot is allowed to remain until suppuration takes place, the treatment is the same as that of an abscess.

In all cases in which the hemorrhage is sufficient to preclude the probability of the clot being absorbed, surgical treatment should be employed without delay, as thereby the dangers of suppuration and blood-poisoning are avoided, and recovery is decidedly hastened.]

IX. Surgical Measures in Extra-uterine Pregnancy.

A large majority of extra-uterine pregnancies end in death from internal hemorrhage within a few months from the date of conception. In some instances, however, the fœtus perishes at an early period without rupture of its investments; and in these, without causing any ill consequences at the time of its death, it may subsequently remain, for indefinite periods, as an encapsuled mass within the maternal organism. In a smaller group of cases neither of these events happens; but the life and growth of the fœtus are prolonged to the full period of gestation, at or about which time, however, it inevitably dies. It is these latter cases chiefly which are likely to become of interest to the practical surgeon.

In a case in which an extra-uterine fœtus has died at the full period of gestation, and remains lodged in its mother's abdomen, several events may ensue. The fœtus may, in the first place, remain without causing irritation, may gradually diminish in bulk, and having been converted into a mass of adipocere, be carried without material inconvenience to the end of a long life. Many instances are on record in which this has been the course of events, and there is abundant proof that a woman may, even without detriment, pass through repeated pregnancies, with an encysted extra-uterine child still lodged within her. The second possible course is, that the fœtus may set up irritation, induce suppuration, and cause ulceration, either through the abdominal wall, or into the vagina or rectum; and that thus a process of natural expulsion may be accomplished. A third event, which, like both the preceding, is exemplified in many recorded cases, is that the fœtus may cause such an amount of constitutional disturbance as will be fatal to the mother before there has been time for any process of expulsion to take place.

The questions, therefore, on which a surgeon, who is called upon to decide as to the treatment to be adopted in a case of this kind, will require information are:[1]—

[1] I have said nothing in respect to the diagnosis, since it is usually not difficult. It may be well to insist on the necessity for great caution before resorting to any opera-

1st. What is the probability as to the fœtus remaining in a quiescent state, should the case be left to nature?

2d. What is the amount of risk that extreme, or even fatal, constitutional irritation may be set up?

3d. If the fœtus set up inflammation, and a process of spontaneous expulsion be commenced, what is the prospect as to the mother's surviving it, and what may be expected to be the amount of suffering through which she will probably have to pass?

4th. Should the surgeon decide to remove the fœtus by an immediate operation, what is the degree of risk attending such a procedure?

5th. Supposing the case to be for the present left to itself, will there occur, at any subsequent time, a suitable occasion for the removal of the fœtus after symptoms of irritation have commenced?

To enable us to reply to the above questions, a very considerable array of cases may be collected, and they are of a character in respect to which the evidence afforded by well-judged statistics may become exceedingly valuable. It is not compatible with the space permitted by the present work to cite the cases themselves; and I am obliged, therefore, to refer the reader who may wish to investigate them more minutely, either to the excellent monograph of Dr. Campbell, or to a series of reports compiled by myself (in large measure from Dr. Campbell's book) and published in the Medical Times and Gazette for July and August, 1860. In the reports in question, I carefully collected all the cases I could find published, amounting in total to no fewer than 102. These may be conveniently grouped under the following heads:—

Group A. Cases in which the fœtus was retained in a quiescent state in the mother's abdomen to the end of her life.—In this group we have twenty-one cases. In three or four instances living children had subsequently been born. The shortest period of the mother's life after the death of the fœtus was four years, the longest fifty-six years. A very much larger number of cases are on record, in which the remains of extra-uterine conceptions were retained for long periods without inconvenience. In most of these, however, there is reason to believe that the fœtus had not nearly attained its full growth, and they have therefore been excluded.

Group B. Cases in which, without any operation, the fœtus set up irritation, and caused the mother's death.—This group is a very important one, since it contains those in which the natural processes were neither interfered with nor assisted, and in which they proved incompetent to the preservation of the mother's life. In not a few of them it is probable that surgical interference at the proper juncture would have saved the patient. In this class we have thirteen cases. In some, death occurred either during the symptoms of false labor, which usually occur at the time the fœtus dies, and last a few days or a week, or within a short period afterwards. In others the mother lived for a few months after the death of the fœtus, and in one for as long as two years and seven months. In none of the cases counted in this group had any abscess given way externally, but in several inflammation of the sac had occurred, which would no doubt, had the patient lived longer, have terminated in ulceration, and an attempt at spontaneous expulsion. The lesson of these thirteen cases seems strongly in favor of interference.

Group C. Cases in which ulceration through the abdominal wall took place, followed by escape of the fœtus.—We have in this twenty-nine cases, in fourteen of which no surgical interference took place; whilst in fifteen, subsequent to the abscess having given way, an incision was practised, and the fœtal remains extracted by the hand. It will be convenient to call this latter procedure *secondary* abdominal section, to distinguish it from *primary* abdominal section, by which we denote an operation performed prior to the occurrence of abscess. Of the fourteen cases in which nature did all, eleven recovered, and two died; the result in one not being known. Of the fifteen in which secondary abdominal section was performed, in one the result is not known, and of all the others all but one recovered. The cases in the next group differ only from these in regard to the position in which the abscess gave way.

Group D. Cases in which ulceration into the vagina or rectum occurred, followed by expulsion of fœtal remains.—In several of these, more or less surgical assistance was afforded in the extraction of bones, etc., as they were protruded from the cyst into the cavity involved. The group comprises twenty-three cases, of which only three ended fatally.

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tive measures. This caution is especially needful in regard to the subjective evidence furnished by the patient. In one case, in which Dieffenbach was the operator, and the measure was resorted to under the sanction of Dr. Heim, no fœtus was found, and the abdomen was again closed without removing anything. Fortunately in this case the woman recovered. At p. 58 of the Medical Times and Gazette for July, 1860, is the narrative of a case in which the history might very easily have misled. The surgeon must rely almost solely on the evidence afforded by manipulation, etc., of the supposed tumor.

There now remain for consideration only the last and very important group of cases, in which the surgeon interfered early, abdominal section being performed before abscess had occurred. In some of these the operation was performed during inflammation of the cyst, and when the patient's constitutional symptoms required that something should be done for her relief; in others it was adopted when all was for the present quiet, and with the object of ridding the patient of a burden, or of preventing possible mischief in future.

Group E. Cases in which primary abdominal section was performed.—In this group we find sixteen cases; out of which six resulted in recovery, and nine in death.

Keeping our attention strictly confined to the question as to the propriety of surgical treatment in these cases, it will be seen that the facts just adduced afford us most valuable guidance. The facts in favor of *secondary* abdominal section are conclusive. No one can doubt that in cases in which processes of suppuration and ulceration have already been set up, it is the surgeon's province to assist in the removal of the decomposing body. The chief point in debate is, therefore, in respect to those cases in which as yet no symptoms have been induced. Let us suppose a woman in perfect health with an extra-uterine fœtus of full growth, and dead, retained in her abdomen. She has probably passed the date at which labor was expected by several months, and is quite free from all uterine disturbance; her menstruation being again regularly established. Ought the surgeon, in such a case, to perform *primary* abdominal section; or ought he to advise the patient to let present well alone, and not submit to operative interference until it should become needful? On the one hand is the fact that a large number of cases similar to our supposed one have been followed by no ill consequences whatever, and that their subjects have lived to old age, in some instances becoming the mothers of living children; on the other hand, we have seen that, in a considerable majority of cases, the retained fœtus does sooner or later set up irritation, and, in not a few, of such a severe character as to cause the death of the mother. If no opportunity for surgical interference were likely to occur again, there might be valid reason for urging the immediate operation. But the fact is, as I have shown, that while primary abdominal sections are very fatal, those performed subsequent to spontaneous inflammation are followed by a large proportion of recoveries. The difference between the two operations is very great indeed. In the one, in all probability, a healthy peritoneal sac is laid open; whilst in the other, adhesions having formed, the incision amounts to little more than opening a large abscess. After the one, the decomposing débris of the placenta, the fetid pus, etc., will have access to the peritoneal sac; whilst in the other they are wholly shut off by adhesions. In the one, a healthy woman is subjected to all the dangers of a sudden and most severe operation, for which her system has been in nowise prepared; in the other, a source of irritation is removed from the organism at the very time when it is becoming felt to a degree almost incompatible with the continuance of life. Whoever shall carefully examine the cases to which I have referred will, I think, come to the conclusion that the longer the interval allowed to elapse between the death of the fœtus and the operation for its removal, the less the danger of the latter. Dr. Campbell regards the operation as not advisable until after "the system of the parent has been restored to its unimpregnated condition, and nature has evinced a disposition to remove the extraneous mass." The difference in risk at different times has, however, in all probability much more to do with the state of the peritoneal sac as regards adhesions than with any other condition. The longer the operation is deferred, and the more prolonged the inflammation, the greater is the probability that efficient adhesions will have formed.

As regards the operation itself, little need be said. The tumor should be opened over its most prominent part, and sufficiently freely to allow of the introduction of the hand. Unless the placenta be found detached, it ought not to be removed, but left to come away afterwards. The attempt to detach it might very possibly tear through the cyst, and open into the peritoneal cavity. If no adhesions between the cyst and the parietes be found, the opening in the former should be brought well forward into the wound, and then secured by sutures. The after-treatment should be conducted on general principles.

[During the last ten years marked advancement has been made in the surgical management of extra-uterine pregnancy. A more perfect knowledge of abdominal surgery and of antiseptic treatment has rendered laparotomy a safer operation, and consequently made it advisable in a greater number and variety of cases. This operation has been performed in abdominal pregnancy at full time to effect the delivery of a living child. It has been advised in tubal pregnancy, when the life of the patient is in danger from rupture of the sac, and slow but persistent hemorrhage.

Dr. T. Gaillard Thomas treated suc-

cessfully a case of tubal pregnancy by elytrotomy. He incised the vaginal wall and the sac with the galvano-cautery knife and extracted the fœtus. For a full description of this operation, and for the subject generally, see Thomas on the "Diseases of Women," p. 744–7.]

X. Operations for Rupture of the Perineum and its Consequences.

Rupture of the perineum occurring during the passage of the fœtal head may vary very greatly in its extent. If it involve only a limited extent of the anterior edge, it is of little consequence, and may be disregarded. If, however, it extend backwards through almost the entire length of the structure, there will be great risk that if nothing be done the patient will hereafter suffer from prolapsus of one or other of the pelvic viscera. In a still more severe class of cases, the sphincter of the bowel is also torn through, with the result of incontinence of feces. In all cases except those first mentioned, in which the laceration is trivial, it is very desirable that the rent should be closed. Should opportunity occur immediately after delivery, it cannot be done too early. The edges of the tear should be well cleansed, and secured firmly in apposition by deep sutures in the manner about to be described. It is quite possible that the bruised condition of the parts, the presence of lochial discharge, and the state of the patient's health, may interfere with union; but even should they altogether prevent it, nothing will have been lost by the attempt.

Should no operation have been performed immediately after the accident, or should it have failed to secure union, the patient will probably come under care subsequently, suffering either from prolapsus or inability to retain her feces, or from both. Whether the sphincter ani has been torn or not, signifies but little as regards the operation to be performed. It is remarkable that it is as easy to procure union in the more severe as in the slighter cases, and the mode of operating is very similar in both. With regard to the relief of the two classes of symptoms, however, it is widely different. If the sphincter ani have been torn through, the patient may be safely promised that an operation for the restoration of the perineum will be effectual in giving her full control over the lower bowel; but it is impossible to speak so confidently as regards the lesser evil of prolapsus. [The experience of surgeons at the present time will not, I believe, corroborate this statement. There is much greater liability to failure in the operation for the restoration of the sphincter ani than in that for restoring the perineum.] With respect to the degree of advantage to be expected as to the prolapse, the reports of those who have tried these operations vary considerably. Those who appear to have examined the matter most candidly, confess that in not a few cases considerable disappointment followed; and that although benefited for a time, the prolapse subsequently returned. We can have little difficulty in understanding this, if we bear in mind that the severest forms of prolapsus, whether of uterus, rectum, or bladder, are quite compatible with perfect integrity of the perineum. Other causes besides want of support below, usually conduce to the descent of the viscera into the vulva. Still there can be no doubt whatever in the minds of those who have seen much of these cases that loss of the perineum favors prolapse, and that its restoration does much to obviate it. With regard to the degree of benefit obtained, much will depend upon the mode of operating. If, as in several cases on record, the operator contents himself with simply denuding a narrow strip on each side the vulva, and uniting the parts across, a thin perineum, consisting of little more than integument, will be the result; and the most that can be expected will be, that what was complete prolapsus may subsequently not amount to more than procidentia. If, on the other hand, the denudation be carried high up into the vagina, and the parts carefully united very deeply, the lower two inches of the canal may be very greatly narrowed, and a very effectual impediment to the descent of the viscera afforded. Although operations with this object have been performed in England during the last few years by many surgeons, and with considerable frequency, yet but few data are on record by which to estimate the ultimate benefits. I may therefore, perhaps, be excused for referring to my own individual and but limited experience.

Including three cases in which the sphincter ani was also torn through, my operations for restoration of the perineum, in order to obviate prolapse, have been ten in number. In none did any untoward results occur; but in one no union was obtained. In two or three, to my knowledge, the patient suffered from procidentia more or less during subsequent years. In three others I lost sight of the patients within a few months of the operation, there having been no relapse whilst they remained under observation. In three I can speak confidently as to the permanency of the relief afforded, since I had opportunities of examining the patients several years afterwards. In one instance the patient, an elderly woman, who before the operation suffered from complete prolapsus in a most

distressing form, the uterus being swollen and deeply ulcerated, received most signal benefit. I examined her repeatedly during the two years following, and always found the uterus high up in the vagina. She lived six years afterwards; and I was assured by her daughter that up to the time of her death she had remained quite free from her old malady.

The operation for making a new perineum is conducted on the same plan whether the sphincter ani be torn through or not. The cicatrized edges of the laceration are to be freely denuded, and

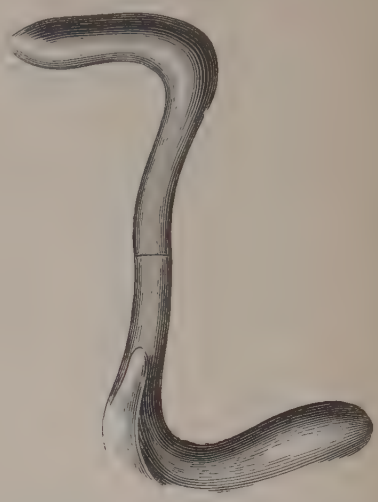
Fig. 532.

Perforated metal splints, for use in the operation for ruptured perineum.

the parts united by deep quill-sutures. The sutures may be tied over a piece of quill, a rod of glass, a piece of bougie, or, what I prefer most, a perforated metal bar. I have used those figured in the woodcut in several cases, and found them exceedingly convenient. The wires are brought through the holes and then twisted round the little pegs. This allows of any single wire which may appear to be not tight enough, or too tight, being readjusted with great ease.

During the operation the patient should be under the influence of chloroform, and in the lithotomy position. The vagina should be well opened by means of the duck-billed speculum, and a plentiful supply of ice should be at hand to arrest the bleeding. It is desirable to denude extensively, both as regards the length and the thickness of the new perineum. Very much, as to the degree of relief to the prolapsus, will depend upon whether a good thick cushion is obtained or only a thin cutaneous one. It is desirable also to narrow the vagina for some distance. These important ends are best secured by dissecting up the mucous membrane of the vagina, posteriorly and laterally, for a considerable length upwards. Immediately in front of the rectum the denudation should extend an inch and a half up-

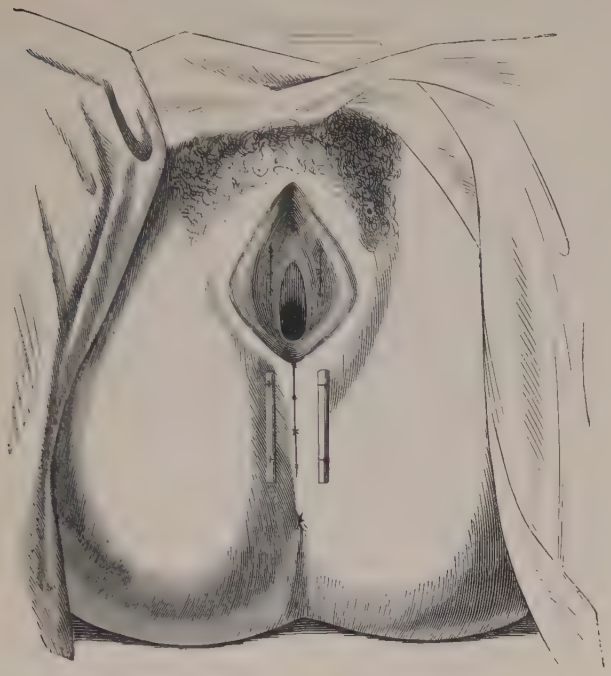
Fig. 533.



A modified duck-bill speculum; the most convenient form for vaginal operations. (Pratt's modification of Sims'.)

wards, and from this point it may slant laterally on each side, downwards and forwards, to the point selected as the front edge of the new structure. The dissection should begin from below. Instead of cutting away the flap of mucous membrane, I much prefer to adopt a plan somewhat similar to that of Fricke. The mucous membrane is turned upwards into the vagina, and the deep sutures are passed, the one nearest to the rectum being introduced into the full depth of the denuded tract, *i.e.*, an inch and a half from the orifice. The other sutures will pass to less depths, the most anterior one being the shallowest. The flap of mucous membrane is now freely trimmed at its sides, and is united by wire sutures to the anterior edges of the new perineum. It thus slopes forward, covering over the deep surface of the newly-united parts and extending their whole length. This flap is nourished by its attachment above to the vagina, and, according to my experience, there is no risk of its sloughing. I believe that it materially favors union by preventing vaginal discharges from gravitating into the wound; and it also greatly thickens and strengthens the new perineum. Of course, when the rectum is torn high up, a central flap cannot be obtained; but I should still, in these cases, incline to save as much as possible of the lateral ones. The parts should not

Fig. 534.



The perineum after coaptation by deep sutures.

be closed until the bleeding, which is often rather free, has a good deal diminished. A recurrence of hemorrhage within a few hours of the operation is not very unusual; and, with a view to its prevention, it is well to leave a fragment of ice in the vagina, and to apply an ice-bladder externally. Some operators have insisted strongly on the importance of freely dividing the sphincter ani; and in cases in which the laceration extends high into the bowel, this measure is undoubtedly important. [Division of the sphincter ani is not now practised in this country so far as I know.] In cases in which the sphincter has not been torn, it is certainly unnecessary to divide it; and even in some in which it has been so, excellent results may be obtained without.

In the after-treatment the bladder should be kept empty and the bowels confined. The sutures should not be removed until the sixth or seventh day, and, however favorable the result, the patient should be made to keep her bed for at least three weeks.

The recumbent posture made necessary by the operation is, no doubt, an important part in the cure of the prolapsus for which the operation is often performed. It allows time for a swollen and, perhaps, ulcerated uterus to diminish in bulk and weight, and for its stretched ligaments to shorten.

[The operation for partial and complete laceration of the perineum, as practised by American surgeons at the present time, is so far in advance of the above methods that I deem it advisable to give the whole subject in detail.

The following is taken from the admirable description of the methods of operating given by T. Gaillard Thomas in his work on "The Diseases of Women," page 192 to 203.

"*Operation for partial rupture.*—It is a matter of great surprise to me that no distinct separation should be made by writers between the descriptions of operations for partial and complete rupture. The first is a procedure in which the merest tyro should succeed. The second is one of the most delicate and uncertain operations in gynecology, in which even the most skilful may fail. I feel sure that evil has arisen from confounding a simple and a difficult procedure, and shall make a wide difference between them.

"The operation for partial rupture has for its sole object the restitution of the perineal body. That for complete rupture has for its main object the restoration of the power and functions of the sphincter ani. After the main object of the second operation has been attained, that of the first should claim attention.

"Let the operator keep clearly in mind the shape and dimensions of the body which he is about to restore. It is a triangle with apex

above and base below. Two surfaces of this shape are to be vivified and held face to face by sutures. That is the whole operation.

"*First part of the operation.*—The patient, dressed for bed, should be placed upon a table before a window admitting a strong light, in the position for lithotomy, and put under the influence of ether. Four assistants will be serviceable, although three would answer the purpose. One of these should administer the anæsthetic, one should hold each knee, and a fourth should attend to the duty of handling the required instruments to the operator, and washing the sponges as they become bloody. The assistants, lifting the feet from the table and flexing the thighs so that the edges of the tibiæ will be horizontal, should hold the knees clasped under the arms and steady the feet with the hands of the same side, while the unoccupied hands of the other side retract the labia and expose the ruptured part. These directions should be observed by the assistant holding the right knee; he who holds the left should do so with the right arm, clasping it with this and retracting the labium with the right hand, while with the left he cleanses the wound with sponges held in long handles, which do not cause his hand to obstruct the operator's view. It will at first appear that it would be difficult for one assistant to do all this. Let him who thinks so try it, and he will find that it is not so, and that such arrangement of his aids will be greatly to his advantage. This operation, like so many others in surgery, often fails, or at least drags heavily in its progress from the want of a sufficient number of assistants, to each of whom is allotted an especial duty.

"All being now ready, the index and middle fingers of the two assistants who hold the knees are fixed upon the labia by the operator, and, the degree of traction which they are to practise being regulated, the operation is begun.

"Seizing the tissue just above the anus with toothed forceps or a tenaculum, a strip of mu-

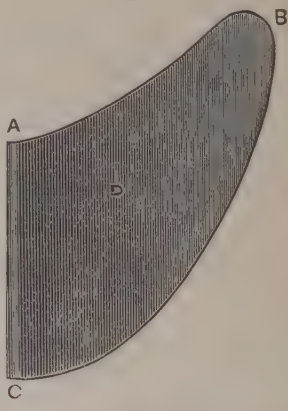
Fig. 535.

Schematic view of part to be denuded (Thomas).

cous membrane is removed from the posterior vaginal wall and from the original site of the perineal body upwards as far as it is proposed to extend to the rectal side of the triangular denudation to be created on each side. Fig. 535 will show this very well. The furrow just alluded to will extend from D to B. It should always be carried to the point where the normal curve of the posterior vaginal wall is altered in its course, by loss of perineal power, and begins to take an excessive and abnormal curve, the whole wall being now shaped like S. One great object of the operation is to change the shape of this wall of the vagina from A B D to A B C. Before this is done, pressure upon it will cause the lower portion of the S to sag forward. After it is done the whole wall, under pressure from above downward, will be supported by the sacrum and the tissues which lie upon it for its upper curve, and by the perineal body for its lower.

"We have now formed what is to be the base and line of union of two triangles, which meet upon the furrow just created. Now catching up the tissue on the inner side of one labium majus, about midway between meatus and anus, another furrow is cut extending down to the anal origin of the first furrow, and another is then carried from the point selected on the labium backwards to the upper or vaginal extremity of the basic furrow. A triangular space, covered by mucous membrane, mapped out by three bleeding furrows, will be left, as shown in fig. 536.

Fig. 536.



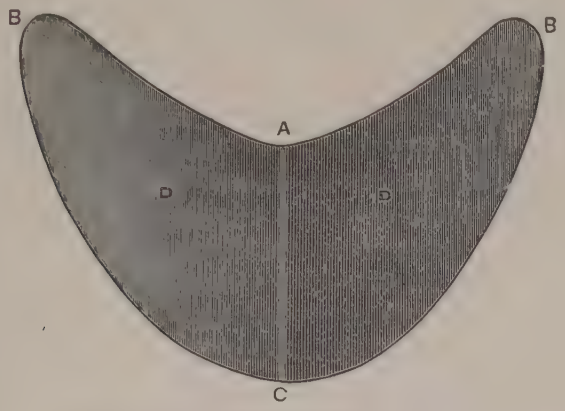
One of the bleeding triangles which are to be created (Thomas).

"C A, furrow extending from anus up the vagina (the rectal side); C B, furrow extending from anus to point midway up labium majus (cutaneous side); B A, furrow extending from point on labium to vaginal extremity of rectal furrow (vaginal side). Now the tissue in the unabraded triangle D is removed by tenaculum and scissors, as little tissue as possible being cut away, and a bleeding triangle is left. The opposite side is similarly treated, and the result is two such triangles placed base to base upon the line C A. The doubling over of these upon each other, and the securing them in contact by suture, con-

stitute the second part of the operation, as shown in fig. 537.

"In performing the first part of the operation, I very commonly begin on one side and cut successive strips across until the whole surface is pared; but the method which I have mentioned simplifies the procedure, and after adopting it once for the complete understanding of the operation the operator may afterwards do otherwise.

Fig. 537.



The two bleeding triangles about to be united (Thomas).

"The whole surface having been pared, the operator stops and carefully examines to see if any arteries are spouting, and if any undenuded surfaces still remain. If he find the former he twists them, and, if necessary, ties them with very delicate silk ligatures, which he cuts short; if the latter, he catches them with the tenaculum and with the bistoury cuts them away.

"The first step of the operation is now finished. The operator should not hasten to the second, for the tissues should be exposed for a while, that he may be assured against hemorrhage. Sutures should never be applied until all hemorrhage has been checked.

"*Second part of the operation.*—Now taking in the needle-holder a round, curved, or straight needle, about two and five-eighths inches long, which will cause less hemorrhage than the needle with cutting edges, armed with a doubled silk thread, giving a loop about eight or ten inches long, he inserts it opposite the lowest external angle of the vivified triangle, which would be a little above the level of the anus, and makes it pass across the middle of the united bases of the triangles, over the rectum, and emerge at a corresponding point on the opposite side. This suture is nowhere visible within the vagina, for it lies embedded in the tissues lying over the rectum. It may be passed by one sweep, or, if this prove difficult, may be drawn out at the middle of its course, and reinserted. This suture is twisted at its extremities and left in position, and, another being taken, it is inserted above the first, and made to pass through the tissues at a higher point of the vivified surface. Guided by the finger in the rectum, it is kept embedded in the recto-vaginal septum, and emerges at a point on the other side, corresponding to that of entrance.

"This, like its predecessor, I am in the habit of concealing in the tissues, so that after its passage it is nowhere visible within the vagina. I believe that an embedded suture excites much less irritation on the denuded surface, and acts less like a seton upon it than an exposed one. In this way sutures of silk are passed, and by them those of silver are immediately drawn into place, about one-third of an inch apart, and inserted at a quarter or half an inch from the edges of the wound. All these are concealed from view, except the last one or two, which should pass under the upper angles of the triangles, and catching up the vaginal tissue at the highest point of the denudation, should bring them all together.

"At each side of the perineal triangle thus formed, two pockets may be created in which putrid materials may collect. To avoid this great care should be taken to conceal the sutures, especially at these points. Denudation should likewise be most carefully practised there.

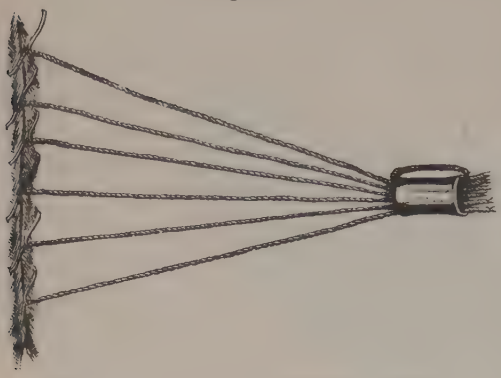
"For the details, as to the method of drawing the wires into place and twisting them, the reader is referred to the article on Vesico-vaginal Fistula. After the plan there described, he twists them one after the other from below upwards. If it appear necessary, superficial sutures are then passed between the deep ones to approximate the cutaneous surface more completely.

"At the risk of being considered prolix, I offer still another diagram [omitted here], giving a profile view of the sutures in position, and pressing one triangle against its opposite. The sutures will be seen to run back and pass

through the posterior vaginal wall, dragging this forward as a background or base to the two opposed triangles now to become an artificial perineal body.

"The sutures should not be cut short, but left about two inches long, then twisted together and secured by a small piece of India-rubber tubing, after a plan suggested by Emmet, and shown in fig. 538. The patient is then put to bed; the knees are bound together; the dorsal or lateral decubitus preserved; the urine drawn by catheter every six hours; the vagina kept clean by syringing with tepid water; and the diet made nutritious, though mild and unstimulating.

Fig. 538.



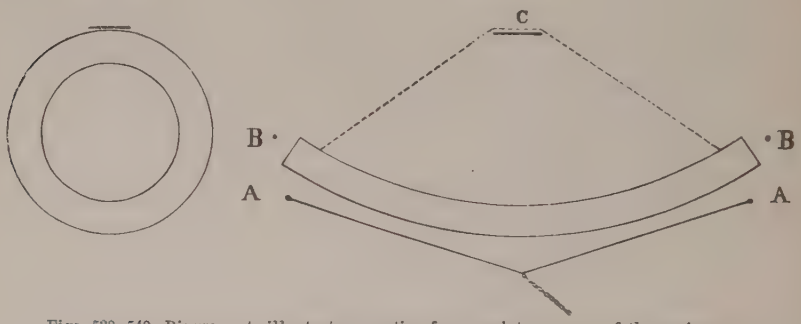
Mode of sewing the ends of the sutures (Emmet).

"On the eighth or ninth day the sutures should all be removed, and on the next the bowels should be acted on by a saline cathartic, great care being observed to prevent tenesmus.

"*Operation for complete rupture.*—Complete perineal laceration always involves rupture to a greater or less extent of the anterior wall of the rectum. If rupture of the bowel extend for more than from one inch to an inch and a half above the upper edge of the sphincter ani, it is better to close it by a primary operation, consisting of vivifying its edges and uniting them down to the anus. After union of these parts, closure of the perineum may be practised. If the bowel be not injured above an inch and a half from the sphincter, one operation will suffice to close the whole. I would not be understood as making this a dogmatic rule, but merely one which approximates the line of conduct which I deem best.

"The sole object of the operation for partial rupture is restoration of the perineal body. The objects of the operation for complete rupture are: first, restoration of the sphincter ani muscle to all its power and functions; second, closure of the rectal opening; and third, restoration of the perineal body. What constitutes the main object in the first operation, is the least important of those striven after in the second. The operator must then appreciate that mere closure of the rent in the genital fissure is not what is desired.

Fig. 539. Fig. 540.



Figs. 539, 540. Diagrams to illustrate operation for complete rupture of the perineum.

He may gain this and not benefit the patient in the least, for incontinence of feces and gases may continue. Success involves always complete union of the ends of the severed muscle, and complete closure of the rent in the bowel. To secure these the ends of the muscle, spread out and expanded, must be curled up and approximated, and the recto-vaginal septum must be drawn up and united to them. With these facts in view, clearly defined and appreciated, the difficulties of the operation greatly diminish. To no one are we so much indebted for their demonstration and illustration by practical results, as to Dr. Emmet, of this city, who, in 1873, wrote a valuable paper upon the subject, giving a clear exposition of the peculiar action of this accident upon the sphincter ani, and of the best method of restoring it to its normal shape and functions.

"Let fig. 539 represent the perfect sphincter, fig. 540 will show it ruptured and spread out, with the point of insertion and exit of the needles. The dotted line shows the course of the metallic sutures embedded in the tissue. It will be seen that the remaining recto-vaginal wall is a fixed point, and that, as the wire is twisted, the ends of the muscle are elevated, and the three points approach each other as shown at c. As the twisting

goes on, these points come nearer and nearer together, as seen in fig. 541, until at last they unite, as shown in fig. 542. Should the first needle be inserted and drawn out above the end of the broken muscle, as shown in B B, fig. 540, the tissue at this point will be approximated, and the ends of the muscle brought close together, but absolute and complete union will not have been attained, and loss of function will still exist. The first

Fig. 541.

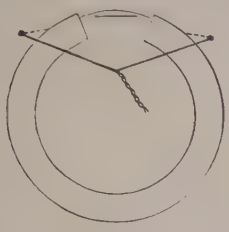
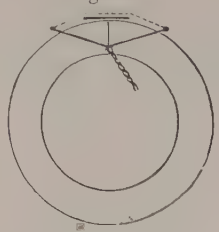


Fig. 542.



Figs. 541, 542. Diagram to illustrate operation for complete rupture of the perineum.

suture is the important one, and must catch the ends of the broken and expanded muscle so as to lift them upwards into contact with each other and with the recto-vaginal septum.

"In vivifying the parts before insertion of the needle, the two lateral triangles, representing the perineal body split in two, are denuded, and the line of denudation is prolonged backwards along the edge of the recto-vaginal septum. The border of the rectal mucous membrane at the extremities of the broken muscle as far as the upper end of the rent in the bowel is the guide for doing this.

Fig. 543.

Schematic diagram showing ruptured bowel, and expanded muscle (Thomas).

"Fig. 543 is a schematic diagram showing the ruptured bowel, the expanded muscle at its anal extremity, the insertion and exit of the needles, and the course (dotted lines) of the imbedded sutures. The line of denudation is marked out by the course of these sutures.

"The rectal rent presents itself to the operator as an imperfect isoceles triangle, apex above and base below. The two lateral borders of this are the parts to be vivified. The two basic angles are on a lower plane than that of the apex, and are less fixed in their position. As the three angles are acted upon by the constricting influence of the encircling suture, as this is gradually twisted, the two movable basic angles are elevated to the plane of that of the apex, while the latter is by traction drawn down to meet them. Coincidently, the denuded sides of the triangle are, of course, approximated, and thus the rectal opening is completely closed.

"To sum up this part of the subject, the rule for passing the first suture consists in the introduction of the needle as low down as the lower edge of the anus. From this point it passes upwards through the recto-vaginal septum, completely encircles the rectal rent, and comes out alongside of the lower edge of the anus on the opposite side.

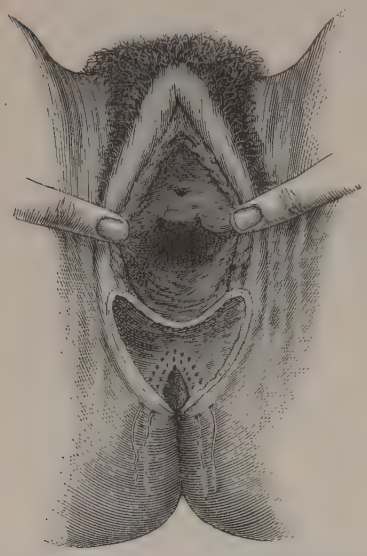
"Let the reader refer to fig. 544, and he will appreciate that a suture which takes this course, like a string at the mouth of a bag, puckers the open parts, draws them into apposition, and controls the action of the sphincter. The two conditions which we have to fear as sources of failure after this operation, are, first, recto-vaginal fistula, and second, non-union of the sphincter. This method, to a great extent, secures us against both. The subsequent steps of this operation are the same as those of that for partial rupture.

"I have, in a large experience with this operation, failed four times. As it is from our past failures that we must learn to avoid failure in the future, I shall strive to give the reader the benefit of my experience. In two of my four cases perfect union was obtained, but the rectum was found, in spite of the fact that in both patients catharsis had been kept up for a week, filled with large, hard, scybalous masses. This created violent tenesmus, and destroyed the newly-formed perineum.

"In the third case, a large bulbous rectal

plug had been left in place, and its removal ruptured the united extremities of the muscles, leaving the perineum whole.

Fig. 544.



Surface denuded in complete perineal rupture, and first two sutures in position (Thomas).

"In the fourth case, the nurse, in using the syringe for a rectal injection, unquestionably passed the nozzle repeatedly between the lowest suture and that just above it, leaving a central opening in the perineum, which constituted a recto-perineal fistula, the sphincteric union remaining perfect.

"Upon the experience thus obtained, I have predicated the following rules of practice, which I invariably observe and strongly recommend:—

"1st. When about to operate for complete perineal laceration, give *two entire weeks* to complete evacuation of all scybalous masses from the intestinal canal. This tract, it must be remembered, is twenty-five feet long, and keeps fecal masses stored up in it for months. Do not practise hyper-catharsis, but let the patient have two medicinal evacuations in every twenty-four hours. This may be done by giving one compound rhubarb or compound cathartic pill every eight, twelve, or twenty-four hours, according to the patient's susceptibility to catharsis.

"2d. During this time, feed the patient freely upon animal food and animal broths, wheat, potatoes, and other nutritious articles of diet.

"3d. During the first four days after operation, sustain her entirely though thoroughly upon strong animal broths alone, avoiding milk especially, which creates scybalæ of hardened casein. The reliance upon milk for avoidance of scybalæ is a mistake.

"4th. Keep the bowels constipated for four days after operation, till primary union takes place. At the end of that time, they should be acted upon by a gentle laxative or enema.

"5th. If a rectal tube be employed, let it be one of small size.

"6th. Should an enema be used, let the physician himself administer it, unless the capacity of the nurse be above suspicion.

"Every surgeon must admit that no detail is too insignificant for his personal attention, which is capable of turning the balance in favor of or against the success of an operation which he has performed.

"I have already stated that sometimes the rectal rent is so extensive that it cannot be closed by the same operation as that by which the perineum is closed. Under these circumstances, which I have encountered several times, colporrhaphy should be first performed, and immediately, or at a later period, perineorrhaphy. The sutures may be passed by a suture with a needle at each extremity from the vagina into the rectum, and be left hanging from the anus, or they may be left in the vagina.

"It is often necessary to perform two operations, one posterior colporrhaphy and the other perineorrhaphy at the same time." . . . . .

"The perineal sutures being removed on the eighth or ninth day, the animal sutures may be left in the vagina to undergo absorption. This prevents the straining of the new perineum necessary for removal of silk or silver sutures.

"After closure of the perineum, should the patient tolerate it, a rectal tube may be introduced occasionally for the escape of air from the bowel, or, in place of this, a large catheter may be kept in recto, though this is not necessary.

"Great danger of separation of the lips of the wounds, even when perfectly united, occurs on the occasion of the first alvine evacuation, when scybalous masses are apt to pass and to tear the newly united parts asunder. As I have stated, I have twice had this happen in my experience in operations performed in private practice. To prevent this unfortunate occurrence, some keep the bowels acting daily from the time of the operation. Formerly, I kept them constipated until removal of the sutures; now, in consequence of the accidents to which I have alluded, I adopt the plan which Granville Bantock indorses in an excellent monograph upon this operation (On Rupture of the Female Perineum, London, 1878), that of keeping the bowels quiet for three or four days, and then acting upon them by laxative enemata.

"A variety of substances are now used as sutures in this operation. The Germans, following the lead of Simon, still cling to silk; in England and America Sims's silver wire is very generally used; but some follow the advice of Lister in employing catgut, while Bantock has a strong bias in favor of the gut of the silk-worm."

XI. Laceration of the Cervix Uteri.

Laceration of the cervix uteri is one of the most frequent injuries incident to

child-bearing, giving rise to much suffering, if left uncared for.

Attention was called to it as early as 1851 by Sir James Y. Simpson, but the importance of its pathology and of its general and special management was not known to the profession until 1869, when Dr. Emmet published his first paper on the subject. The discussion of the character of this affection and the means devised for its successful treatment by Dr. Emmet stand foremost among the discoveries of that distinguished author, and are certainly among the most valuable contributions to the gynecology of the present age.

The laceration most frequently seen is bilateral, involving all the tissues of the cervical walls and extending upward to the vaginal attachment. There are, however, several variations in the location and extent of the injury. The mucous and middle coats may be torn, while the outer tissues remain uninjured; or the laceration may involve but one wall, lateral or posterior. Occasionally there are three or more lacerations radiating from the canal, giving a stellate appearance.

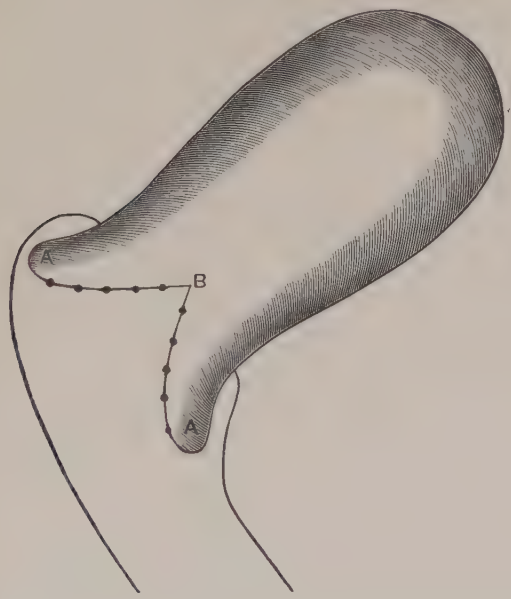
The results of this injury vary greatly in different cases. In some the torn edges heal over without uniting, and no unfavorable consequences follow. In others, the process of involution is arrested, either in consequence of the laceration or from other causes, and then follow hyperplasia, eversion, catarrhal inflammation, and finally cystic degeneration.

The causes of this accident, so far as discovered, are changes in the structure of the cervix, which impair its dilatability; precipitate labor; and manual and instrumental delivery.

The symptoms developed by this injury are variable in character and severity. It is usually accompanied by sacral pain, discomfort in walking, pelvic tenesmus, leucorrhœa, and sometimes by derangement of the menstrual function. In a large majority of cases it causes sterility.

The physical signs of laceration of the cervix are obtained by the touch and by speculum examination. When the inner and middle coats alone are lacerated, the canal of the cervix is abnormally large, admitting the finger with facility. The remaining outer coats of the sides lacerated are so thin as to contrast in a marked degree with the other portions of the

Fig. 545.

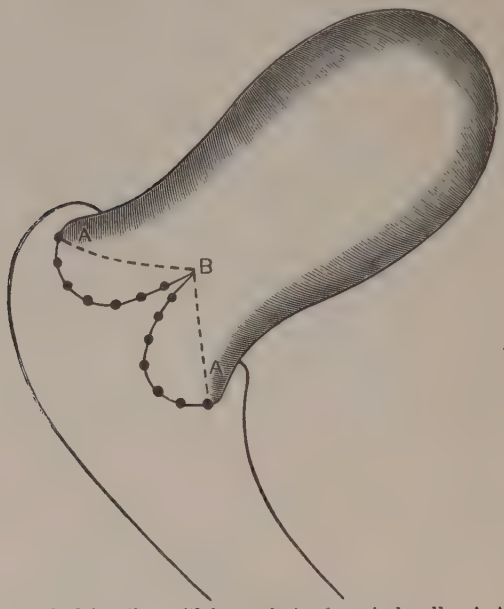


Bilateral laceration to vaginal junction. A, A, lips of the severed os externum. B, os internum (Thomas).

cervix, which present their normal thickness. In bilateral laceration the two halves of the cervix can be felt, separated by a notch or fissure. The multiple form of laceration presents to the touch a nodulated condition. Examination by Sims's speculum—the only instrument suited to the investigation of this affection—will show the exposed mucous membrane of the cervical canal in case there is eversion. When there is no separation of the divided sections of the cervix, they can be

drawn apart with a tenaculum. To demonstrate the extent of the laceration, the two halves of the cervix should be seized at points corresponding to the lips of the os externum, by two crossed tenacula, and the parts drawn together. By this means the proper form of the cervix can be partially restored, and the location and extent of the laceration brought into view. Fig. 545 shows a bilateral laceration up to the vaginal juncture, Fig. 546 illustrates the same laceration, the two halves of the cervix being enlarged from areolar hyperplasia.

Fig. 546.



Bilateral laceration to vaginal junction, with hyperplasia of cervical walls. A, A, lips of severed os externum. B, os internum (Thomas).

The treatment consists in reuniting the divided parts by trachelorrhaphy. Preparatory treatment is necessary when the tissues of the cervix are abnormal. Cysts, if any exist, should be freely laid open. Hyperæmia should be relieved by the free use of hot water injections and applications of iodine. The uterus should be held in position by a pessary or tampon, if there is any displacement requiring such treatment.

In restoring the cervix I greatly prefer to operate without anæsthetizing the patient. In the record of my last sixty-five cases I find that ether was used in two, and nitrous oxide gas in one. The pain of the operation is trivial compared with the suffering from the after-effects of an anæsthetic, and the chances of a good result are increased by avoiding that disturbance of the sutures caused by the vomiting which so frequently follows the use of ether or chloroform.

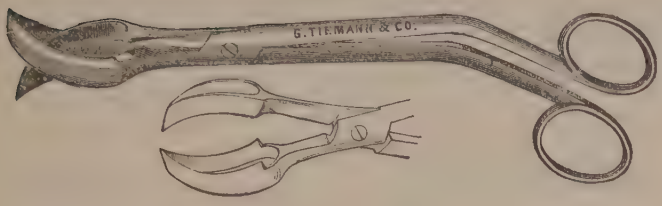
The operation is performed as follows: The patient is placed upon the left side and a Sims speculum introduced and held by a trained nurse or assistant. A tenaculum forceps, curved upon the flat side (see fig. 547) is fixed in the anterior half of the cervix, at the point which makes the lip of the os externum. The posterior half of the cervix is seized in the same way with a similar forceps, and the operator, taking a forceps in each hand, brings the two flaps together, in order to see exactly where the parts are to be united. The forceps which holds the anterior flap is then given to an assistant while the one attached to the posterior flap is held in the left hand of the operator, and the surfaces are denuded by the hawk-bill scissors, shown in fig. 548.

The parts of the scissors are made to seize the angle formed by the junction of the two flaps as far up as appears necessary. The flaps are brought together by the aid of the forceps on each side, so as to bring the tissues more within the grasp of the scissors. The blades of the scissors are then closed, and a strip is removed from above downwards on each flap. The same manipulation is repeated on the other side, and the denudation is completed. It frequently happens that a portion of the tissue to be so removed escapes from the scissors at the lower por-

Fig. 547.

Curved tenaculum forceps.

Fig. 548.



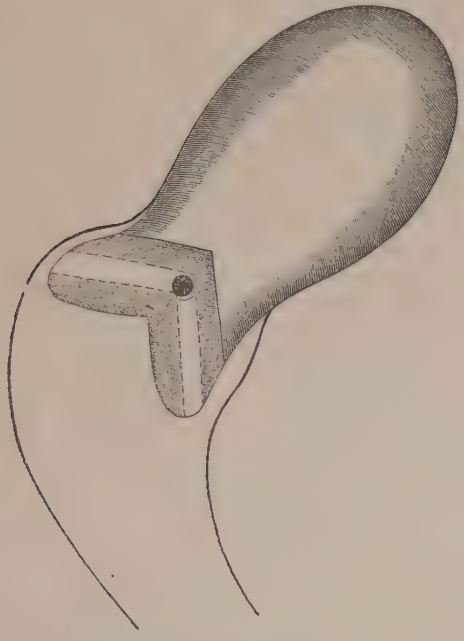
Hawk-bill scissors.

tion of the flaps, on one or both sides, but that can be easily trimmed off with curved scissors.

The most difficult part of the denudation is at the angle formed at the juncture of the flaps, if the curved scissors are used, but with the hawk-bill scissors that portion of the denudation can be accomplished accurately and with facility.

Fig. 549 shows the two denuded sur-

Fig. 549.



Lacerated cervix denuded, and strip of undenuded surface left to act as a cervical canal (Thomas).

faces on each side of the laceration, and the strips of mucous membrane between.

Silver wire sutures are generally used, but I prefer silk. It is much more easily handled, and when properly prepared, is as innocuous to the tissue as the metallic suture. Braided silk, No. 7, is prepared by being immersed for several hours in

melted beeswax mixed with five per cent. each of carbolic and salicylic acid. When thoroughly saturated the silk is passed through a hole in a piece of cardboard, or the eye of a needle, to remove the excess of wax.

The needles used are triangular, pointed, and about three-quarters of an inch long. The needle-forceps which I employ is made to obviate two difficulties. First, the tendency of the needle to slip while passing the suture on a curve, and secondly, the danger of spoiling the point of the needle in withdrawing it. It is a double forceps, composed of two halves, the central portions of which are made of elastic steel, which forms the handle. These halves cross at each end and terminate in the jaws of the forceps. At one end there are three grooves in the jaws, admitting the needle, and holding it at either an acute, obtuse, or right angle, whichever the operator may require. There is a flange which projects from the upper jaw, down over the groove in the lower jaw, to prevent the needle from slipping back when pressure is brought to bear in passing it through dense tissue. The other end of the forceps has jaws faced with soft copper. This is used to grasp the point of the needle in drawing it through. Fig. 550 will give a correct idea of the mechanism of this instrument.

Fig. 550.

Double needle forceps.

The needle is placed in the groove which will give the desired angle, and is held immovably there, when the operator grasps the handle and closes the catch. The needle is then passed into the tissues and left there while the forceps is unclasped and withdrawn; its other end is then applied to grasp the point of the needle and draw it through.

The first two sutures are introduced at the lower end of the flaps, at points corresponding to the sides of the os internum. While passing the needle and introducing the first two sutures, the parts are held by the tenaculum forceps, which were used during denudation. As each suture is introduced, the ends are united by passing one around the other in a loop-knot. This keeps the sutures from being tangled. The tenaculum forceps are then removed, and while the assistant steadies the cervix by holding the ends of the first sutures, the rest are introduced, a tenaculum forceps being used to make counter-pressure, while the needle is passed.

The sutures are tied as follows: One or two turns of the ends are made to form the first half of the knot, the assistant takes hold of one end, the other is passed through the loop of a counter-pressure tenaculum—an instrument resembling a wire curette—and then seized by the left hand of the operator. Traction is then made on both ends of the suture, and, at the same time, the loop of the instrument is pushed down along the thread to make the knot slip to its destination. Repeating this manœuvre, completes the knot. By this method the sutures can be tied about as easily and rapidly in the cavity of the vagina as upon a free surface. The ends of the sutures are then cut off, and a small tampon of well dressed flax, saturated with pine tar (marine lint) is carefully packed, first around the cervix and then below it. This tampon makes a good antiseptic dressing. It promptly absorbs any serous oozing, and prevents any motion of the uterus which might strain the sutures. At the end of forty-eight hours it should be removed, and if the parts are then in a healthy condition, no further local treatment is required. If there is any suppuration, a fresh tampon should be introduced and allowed to remain for forty-eight hours longer.

From my experience in a large number of cases, I am satisfied that the use of the tampon is a reliable after-treatment in this operation, and is preferable to the daily injection of carbolized water, which is so generally employed. The patient should rest in bed, with the privilege of turning upon either side. The bowels and bladder should be evacuated upon the bed-pan.

The sutures should be removed upon the eighth day. If the union is imperfect, the lower ones may be left in for two weeks.

Pelvic Hematocele.

An accumulation of blood in the pelvic cavity, either above or beneath the peritoneum, is, in the majority of instances, the result of hemorrhage from some of the pelvic or abdominal vessels. Changes in the structure of the bloodvessels or in the composition of the blood itself are the chief conditions which predispose to pelvic hematocele. The exciting causes are

injuries, such as direct blows or falls. There are two varieties of this affection, the subperitoneal and the peritoneal, the latter being the more important.

In the general history of this affection there are three stages: (1) that of hemorrhage; (2) that of inflammation caused by the presence of the blood acting as a foreign body; and (3) the disposal of the blood clot either by absorption or evacuation.

If the surgeon is called while hemorrhage is going on, his first efforts should be directed towards arresting it. The patient should be placed at rest in the recumbent position. The pain should be relieved and the circulation quieted by the hypodermic use of morphia. Cold applications should be made to the lower portion of the abdomen. The circulation in the extremities should be stimulated by hot applications. If there is danger from shock, alcohol should be administered either by the mouth or hypodermically. Should the hemorrhage continue and threaten the life of the patient, it has been suggested that the abdomen be opened and the bleeding vessels secured. Upon theoretical grounds this would appear to be good surgery, but practically it meets with serious objections, because laparotomy so greatly increases the danger, already great, of depression from shock and hemorrhage as to deter the most daring surgeon from undertaking it.

When the hemorrhage has ceased, the practice of the present time is to leave the tumor to be disposed of by nature, except under circumstances to be noticed hereafter. Récamier introduced the practice of evacuating the blood as soon as possible after the stopping of the hemorrhage, believing that the patient would thereby be saved from the dangers of inflammation and absorption. But the experience of Nélaton has proved that there is more danger in that plan of treatment than in trusting to nature to dispose of the blood by absorption.

At the present time surgical treatment is restricted to one condition, viz., that of septicæmia, caused by suppuration in the sac formed by the wall of lymph thrown around the blood-clot and the absorption of the pus. In such cases the contents of the sac should be evacuated.

The usual method of operating is to elevate the perineum with a Sims speculum, and make an incision through the posterior vaginal wall at the most prominent point of the tumor, passing the finger through the opening, breaking down the clot and removing it. The cavity should be washed out with a weak solution of carbolic acid twice a day, to prevent septicæmia. If the wound inclines to close before evacuation is complete, a drainage-tube should be used.

Pelvic Abscess.

Inflammation of the areolar tissue of the pelvis or of any of the pelvic viscera may go on to suppuration and to the formation of a pelvic abscess. The pus may be discharged at some point favorable to the complete evacuation of the abscess, and the case may then end in recovery. Under such circumstances no surgical treatment is required.

Surgical treatment of pelvic abscess is called for 1st, when, after suppuration has occurred, evacuation is delayed for an unusual length of time, and the patient's health is failing in consequence; and

2d. When, after the abscess has opened, and partially evacuated its contents, the discharge still continues, while the cavity remains open, and the patient fails to recover.

There is some difference of opinion among surgeons regarding the proper time to interfere when the opening of pelvic abscess is delayed. Some advise opening as soon as suppuration has been fully established, in the hope of obviating the danger of the pus taking an unfavorable direction. Others advise delay until a reasonable time is given for spontaneous discharge. It may be safely stated that a good rule of practice is to operate when the abscess is pointing in a favorable direction, say towards the vagina, and when its wall at that point is thin and elastic. On the other hand, if the pus is not within easy reach, because of the thickness of the walls of the abscess, it is better to delay, unless the condition of the patient demands relief; in which case aspiration should be resorted to rather than the bistoury.

When suppuration and discharge are prolonged unnecessarily, surgical treatment should be promptly applied.

The usual cause of long-continued suppuration is that the point of outlet is above the lower portion of the cavity of the abscess. Under such circumstances suppuration may go on indefinitely, because a certain quantity of pus remains and keeps up suppurative action. The indications in that case are to secure complete evacuation and thorough drainage.

A pelvic abscess should be opened through the vagina if possible, as that is the safest and most convenient outlet for the pus. Should the abscess point much more directly towards the rectum, it may be opened through that canal. In operating, the point in the vagina selected should be exposed by a Sims speculum, and if there is the slightest doubt regarding the presence or location of the pus,

an exploring needle should be introduced to settle the question. A bistoury is then introduced alongside of the needle, and the opening made. If the discharge is free and of a favorable character, further treatment may be unnecessary; but if the pus is fetid, or if the wound is inclined to close, the cavity should be washed out with a solution of carbolic acid, and a drainage-tube introduced.

As already stated, when the abscess cannot be easily reached, and the long imprisoned pus is affecting the general health of the patient, aspiration should be practised. After evacuating the contents of the sac, the current of the aspirator may be reversed, and a solution of carbolic acid injected, and then withdrawn. The quantity injected should be less than that of the pus drawn off, so that over-distension and rupture of the sac may be avoided. The greatest care should be taken to see that the instrument works perfectly. The injection of air into the sac of a pelvic abscess has been known to prove fatal.

In treating cases in which the abscess has opened, and the discharge continues, or stops for a few days at a time and returns, the opening should be enlarged. If that is not sufficient to secure free drainage, the most dependent portion of the sac should be found by probing, and a counter-opening made. Sometimes recovery is delayed because of a number of small abscesses which open into one another, and discharge through a common aperture. This condition can be successfully treated in some cases by enlarging the opening, passing in the finger, and breaking down the exudation which separates the sacs from one another.

The necessity for using an anæsthetic in these operations for pelvic abscess will depend upon the power of self-control in each patient. If there is doubt about her ability to keep still, an anæsthetic should be given.]

XII. Organic Diseases of the Ovary.

When we consider the peculiar function of the ovary, and the irregular demands which are made upon its activity, it is not surprising that it should frequently become the seat of disease. Restricting our attention in this essay to its organic affections only, we may classify these in two groups—the solid and cystic growths.

The *solid growths* met with in the ovary are, first, fibroid tumors, and second, malignant tumors. The fibrous tumors are decidedly rare. They may in some instances attain very considerable size, and may even approach that of a pregnant uterus; more usually they are much smaller. Their substance is made up of dense fibrous tissue, which replaces the stroma of the organ, and by which the latter is at length wholly substituted. During life it would be difficult to diagnose with any certainty between a fibroid tumor of the ovary and a similar growth from the uterus (if detached and pedunculated); but as the rule of treatment is the same for both, but little practical importance attaches to the question. In both it is desirable to give a fair trial to the bromide or iodide of potassium, or to some natural water holding haloid salts in solution (Kreuznach, etc.). These salts are to be recommended, not so much in the hope of inducing any absorption of the tumor, as of repressing its vitality and arresting its further growth. Solid tumors occupying the abdomen, whether originating from the ovary or the uterus, and whether believed to be innocent or malignant, should not be interfered with surgically. If innocent, they rarely cause death, and at a certain period of life almost always begin to shrink; whilst any attempt to remove them by abdominal section is attended by great danger.[1] If malignant (*i. e.*, medullary), the reasons against their removal, or rather against the attempt at it, are manifold and apparent. The form of cancer (very doubtfully such) most frequent in the ovary is that known as alveolar, or colloid, and the tumor thus constituted is cystic rather than solid. In rare instances, however, medullary cancer occurs as a primary disease in the ovary, and a very large tumor may be thus developed.

Cysts in the broad ligament.—These very rarely attain any large size. They are not unfrequently met with in infants, but are rare in adults. They are supposed to be consequent on cystic dilatation of the tubes of the Woolfian body. They have but little surgical interest, since they rarely attain a size sufficient to call for treatment, or even to be discovered during the life of their possessor.[2]

[1] In these remarks it is intended to include only those tumors which have passed upwards into the abdominal cavity and become pedunculated. Uterine fibroids still occupying the walls of the uterus are treated elsewhere (see p. 993). It must be always remembered that the dangers of abdominal section for solid tumors far exceed those of ovariotomy. As the tumor cannot be diminished by tapping, the incision must be very free, whilst the peduncle, if it exist, is certain to be short, thick, and very vascular.

[2] There is no doubt that occasionally cysts of the broad ligament attain much greater sizes than those mentioned by Dr. West. Many years ago, at St. George's Hospital, Mr. Cæsar Hawkins operated successfully by ovariotomy in a case in which he found the cyst

Cystic disease of the ovary.—This disease may present itself in two forms, either as *simple* or *proliferous* cysts; but the two are very closely allied, and the former may at any time assume the characters of the latter. Again, we must note that the proliferous or compound cysts differ much amongst themselves in the degrees in which their peculiar endowment is developed. Some show but little tendency to reproduction, whilst others exhibit the utmost activity. There is good reason for believing that the simple cysts of the ovary are developed by the dropsical dilatation of Graafian vesicles. Not unfrequently more than one is formed in the same ovary; and at later stages the partitions between them may be broken down, and a single irregularly-chambered cavity may result. Simple cysts may attain a very large size, but the compound ones, as a rule, exhibit greater activity of growth. The *compound* or proliferous ovarian cyst is by very far the most frequent form of ovarian dropsy, and is closely homologous to the cystic diseases of the breast and testis, allowance being made for the different structural peculiarities of these organs. It is probable that the morbid action usually commences in the stroma of the ovary, but it may in some instances originate in the Graafian vesicles. With regard to the contents of ovarian cysts, it may be stated to consist of an albuminous fluid of greater or less density. In simple cysts the fluid is usually thin, but in compound ones it varies from the consistence of a dilute solution of gum-arabic to that of stiff glue. In the latter it often varies very greatly in different cysts composing the same tumor. In color it also presents great varieties, from a clear watery fluid to a dark tar-like one. It often contains sparkling scales of cholesterine in immense quantities. In rare instances ovarian cysts contain a sero-purulent fluid, or even pus. This is more common in simple than in compound cysts, and usually is a consequence of inflammation after tapping. The term "alveolar or colloid cancer," has been applied to a not very infrequent variety of compound cyst of the ovary, in which very numerous loculi exist, and the spaces are filled by a semi-solid tenacious substance resembling gum. This variety, however, not unfrequently complicates tumors in which many cysts contain fluid and resemble those of the common compound form. There is much reason to doubt whether the usual tendencies of true cancer are ever manifested by it. Again, we must note that compound ovarian cysts differ not only in respect to the density of the contents, but also in the thickness of the intervening solid substance. Müller has applied the designation of cysto-sarcoma to those in which the fibrous intercystic substance equals or exceeds in quantity the contained fluid. Here, again, however, all degrees may be observed in different tumors, and even in different parts of the same tumor, and we cannot therefore venture to separate abruptly ovarian cystic tumors into different classes. Good typical examples of all of them—*a*, the simple, single cyst; *b*, the simple but multiple cyst; *c*, the proliferous or compound cyst; *d*, the proliferous or compound cyst with colloid contents; *e*, the proliferous with large sarcomatous formation—may frequently be met with; but in a large majority of instances ovarian tumors share the characters of two or more of these varieties. The more active the proliferous tendency, the further the departure from simplicity of organization, the more nearly does that tumor approach in its relations to malignancy. Whether, however, any form of ovarian tumor, excepting the fungoid (medullary), is truly cancerous in its tendencies, is a matter of much doubt, and practically all must be treated as if it were proved that they are not so.

There is yet another variety of ovarian cyst to be mentioned, that, namely, in which a structure resembling the cutaneous integument (both in structure and function) is formed. These, known as Dermoid Cysts, possess the power of producing in their lining membrane all the appendages of the skin—hair, teeth, etc.—and of excreting into their interior the ordinary secretions of that organ. Thus not unfrequently teeth, balls of hair, or large quantities of fat are found in them. That these structures are, in many instances, in no way connected with impregnation, and are also quite independent of any "included fœtation," is amply proved.

With regard to the relative frequency of the different forms of ovarian disease, Dr. West supplies us with the following data: of a total of sixty cases, forty-one recorded by Scanzoni and nineteen by himself, simple cysts occurred in fifteen; fat-cysts in one; compound cysts (with

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in the ligament and not in the ovary. The specimen is kept in the St. George's Hospital Museum, series xiv., No. 134. The cyst contained nearly eighteen pints. The description in the catalogue does not appear to me to afford any conclusive evidence in favor of the opinion expressed that the cyst was not really ovarian. An undoubted example of broad ligament cyst, large enough to simulate ovarian dropsy, came under my own care two years since. In the performance of ovariotomy, I found that the cyst had absolutely no peduncle, but passed under the peritoneum in the iliac fossa. The ovary lay in it, and was quite healthy.

cysto-sarcomata) in twenty-three; colloid or alveolar in nineteen; cancer with cyst-formation in two.

It has been hastily assumed, from calculations based upon opinions formed during the life of the patient, and necessarily liable to error, that ovarian cysts more commonly affect the *right* organ than the *left*. Post-mortem examinations prove, however, that the two ovaries are equally liable to disease. Dr. West concludes, from the examination of nineteen of his own cases, fifteen of Dr. R. Lee's, and forty-one of Scanzoni's, that in about one-third both organs are affected. A reasonable suspicion may, however, be entertained that this proportion is much higher than more extended data will show.

Ovarian disease may occur at any *age*, from infancy upwards. It is of tolerable frequency during the whole period of sexual activity, but most so during the latter half, *i. e.*, from thirty to forty-five. It is very rare in childhood,[1] and decidedly infrequent after the complete cessation of the menstrual function. It is relatively more common in single than in married women, and of the latter a large number have either been sterile or have manifested but feeble fecundity. No trustworthy inference as to the probable nature of the tumor can be drawn from the age or sexual condition of the patient. Beyond the fact that it is often associated with sterility or a low rate of fecundity, nothing can be asserted as to the causes of ovarian disease. In a majority of cases it develops itself in those whose sexual functions, with this exception, have appeared to be in perfect health.

The *rate of growth* of ovarian tumors is subject to considerable variety. In the majority of cases, in from two to three years from the commencement, or at least from its first discovery, the tumor will have become large enough to fill the abdomen and produce inconvenience by pressure on the viscera. In many the rate of progress is much more rapid; in a few, and especially in the aged, it may be much slower. Beyond the stage described, we are not able easily to ascertain the average natural progress of ovarian tumors, since in a great majority of instances one or other mode of treatment is adopted as soon as the dropsy becomes a serious inconvenience. Such facts as are on record, however, do not encourage the hope that in patients under forty ovarian disease, not interfered with, may frequently be protracted over many years. As soon as the abdomen is distended, the patient's health begins to fail, the process of assimilation is interfered with, exercise is prevented, the demands of the tumor are a drain upon the patient's strength, and she becomes not slowly thinner and more feeble; the tumor still grows, the lower limbs become œdematous from pressure on the veins, the thorax (both ribs and diaphragm) is displaced upwards and fixed, rendering respiration difficult and incomplete;[1] the patient ceases to be able to lie down, and, after a most painful illness, death at length puts a period to her sufferings. That the latter stages of ovarian dropsy should be prolonged over months instead of weeks would be a matter of regret rather than congratulation. In addition to the ills above mentioned, intercurrent attacks of peritonitis are common in the course of ovarian dropsy, and not very unfrequently spontaneous inflammation of the interior of one of the cysts takes place. Either of these occurrences may very seriously reduce the health of the patient, and the latter may prove directly fatal.

Before proceeding to consider the different surgical measures by which relief may be afforded, we must refer to the possibility of *accidental or spontaneous cure*. It is probable that now and then an ovarian cyst may, without having ruptured, spontaneously cease to secrete, and become greatly diminished in size. This termination has, I think, been illustrated in one case under my own care; but there can be no doubt that it is an exceedingly rare one. The rupture of the cyst, either by violence or by ulceration, into an adjacent viscus is much more frequent, and numerous cases are on record in which cures have been brought about in this manner. Notwithstanding an occasional cure so produced, however, the internal rupture of an ovarian cyst is scarcely an event to be desired. In not a few the death of the patient is the immediate consequence, whilst in others recovery only results after severe peritonitis and a dangerous illness. It is of course only in cases of single cysts that any permanently satisfactory result is to be hoped for, and even in these the probability is great that after the rent has closed, re-secretion of the fluid will follow. If instead of rupture into the peritoneal sac, the tumor have ulcerated into the bowel or vagina, all the dangers incident to inflammation of the cyst-cavity will probably be encountered.

We may, then, safely allege that ovarian dropsy is, as regards any probable

[1] Kiwisch alludes to a specimen of cystic disease of the ovary from a child aged one year. I have myself seen a large ovarian tumor in a girl of twelve.

[1] See plates, by Dr. Bright, in Guy's Hospital Reports, vol. ix., or in New Sydenham Society's reprint, p. 90, plate 33, and p. 122, plate 36.

process of natural and spontaneous relief, an incurable disease. Further than this, we may safely add that, putting aside certain exceptional cases, met with chiefly in aged patients, it is a disease which, within from one to three years of its commencement, may be expected greatly to incapacitate its subject for the ordinary enjoyments of life, and at the end of one or two years more to end fatally, after extreme and protracted suffering. In this statement of clinical fact we have the measure of the value of surgical methods of relief. To these latter the reader's attention is now asked.

We have the time-honored plan by *repeated tappings*. Paracentesis can be ranked only as a means of temporary relief, not as affording any probability of cure. On the contrary, there are reasons for thinking it probable that those cases in which it is practised end earlier than those in which it is refused. The operation itself is by no means devoid of danger. Attacks of fatal peritonitis after it are not very uncommon, nor is acute inflammation of the cyst itself a rare event. If the patient recover well from the operation, the drain upon her strength by the re-secretion of fluid which rapidly takes place is greater than would have occurred had the cyst been allowed to remain full, and a second operation becomes needful, to be followed at a still shorter interval by demand for a third. Whilst, therefore, it is fully granted that in certain cases this method results in great temporary relief to the patient, that it may enable a woman who had been wholly incapacitated to get about in comfort for a few weeks, or, it may be, for a few months, still there is, I think, as little doubt that it is in the long run prejudicial to the prospect of life. We must also recollect that in numerous cases—those, for example, of multilocular tumors—in which no one cyst greatly predominates in size, paracentesis can do little or nothing even for the reduction of the patient's bulk.

Various means have been devised with the hope of securing *obliteration of the cyst-cavity after paracentesis*. Amongst the chief of these we have: 1st, the application of very firm pressure over the abdomen; 2d, the exhibition of mercury; 3d, the injection of iodine into the interior of the cyst; and, lastly, the attempt to establish fistulæ, by which the re-secreted fluid may drain away.

The idea of preventing the refilling of a cyst by sheer *mechanical compression*, from without, is not one, at first sight, likely to claim our approval. It is, moreover, impossible to compress an ovarian cyst above; and firm lateral support will very probably only cause greater inconvenience to respiration by compelling the cyst to bulge upwards. Although a few cases of supposed cures, under treatment by starch-bandage applied to the abdomen, combined with the free administration of mercury internally, are on record, yet the plan has, even by the confession of its advocates, enough of drawbacks to prevent its coming into use; and it is, I believe, at the present time not resorted to by any surgeons.

The establishment of *fistulous channels* communicating with the interior of the cyst may be effected either through the abdominal wall or into the vagina or rectum. After tapping the cyst a flexible catheter is passed through the canula, and the latter having been withdrawn, is there retained. The disadvantages of this plan are such as to have led to its almost entire disuse. It is attended by great risk to life, probably not less than that attaching to ovariotomy. It attempts the obliteration of only one cyst: it is a long, painful, and exhausting method; and lastly, even when cure has been obtained, there is no certainty that it will prove permanent.

In some cases, instead of establishing a small fistula by means of a retained catheter, a large opening has been made into the cyst by incision, and the edges of it carefully secured to those of the wound in the integument. The drawbacks just enumerated will be found at least equally real in respect to this method also.

The plan which, next to that of the entire removal, seems to promise most as a means of radical cure, is that by *injection of iodine*. In a few cases of single cysts this method is certainly very useful, and with due caution is attended by but little risk. Still we must bear in mind that the dangers consequent on a mistake in the differential diagnosis between ascites and ovarian disease are much greater if iodine be injected than if ovariotomy be attempted. Such mistakes have occurred; and it is precisely in the cases most suitable (were the diagnosis correct) for injection treatment—those, namely, of thin-walled single cysts—that the mistake is most likely to happen. Then, again, if the tumor be multilocular, it is exceedingly probable that the secondary cysts will be irritated by the inflammatory processes set up in the larger one. Even when the chief cyst has to all appearance been permanently obliterated, the surgeon can never feel confident that there may not be others left behind it, which, sooner or later, will enlarge. To these drawbacks we must add that, even in the most suitable cases, it is quite possible that the patient may be poisoned by the iodine, or may sink under the attack of cyst-inflammation which follows its use.

Premising that the injection method

is only admissible in the case of tumors believed to be monocystic, it may be granted, I think, that it exposes the patient to less risk on the whole than does ovariotomy. In this class of cases it is probable that it will continue to be occasionally employed. There are several different methods in which it may be practised. Either the iodine may be diluted in a large quantity of water, or it may be employed in a concentrated solution. The former was the method recommended by its introducer, Boinet; the latter is the one which has of late been considered preferable. The free dilution of the fluid diminishes the caustic action of the iodine on the lining membrane of the cyst, whilst it much favors its absorption into the patient's blood. Even with the most careful endeavors to empty the cyst, there always must remain in its interior a certain quantity of fluid, quite sufficient to dilute the most concentrated injection which could be employed.

In performing injection the cyst-fluid should first be evacuated in the usual way, by paracentesis, the patient being on her side in bed. When the cyst is three parts emptied, a flexible catheter should be passed down the canula. This should be sufficiently large to fill the canula, and both should be retained. The cyst-fluid should be patiently allowed to drain away as completely as possible, the patient's posture being changed as may seem most suitable to this end. When no more fluid can be obtained, the iodine solution is to be injected, and, having been retained for ten minutes or a quarter of an hour, may be allowed again to drain out. Finally, the catheter and canula are to be withdrawn together, in doing which the surgeon must be very careful to have his finger over the end of the former, to prevent the escape of drops of iodine-fluid into the peritoneum, during the passage of the end of the instrument through the wound.

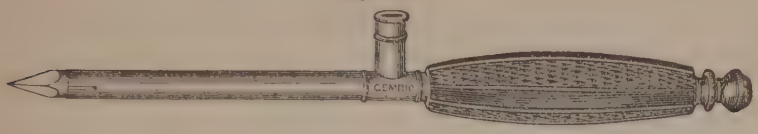
The after-treatment must consist in the use of ice, and of stimulants or opiates according to the symptoms which may arise. If, in performing the preliminary paracentesis in a case in which it is intended to inject, the fluid should be found too thick readily to escape by the canula, this plan of treatment should, I think, be abandoned, since it is very probable that the tumor is polycystic; and even if not, the mere density of the fluid will very greatly prevent the efficiency of the injection. [Tapping ovarian cysts as a means of cure is now obsolete. The same may be said of pressure, of the use of mercury and other drugs, of injections of iodine, and of drainage through induced fistulæ.]

Having thus briefly adverted to the less complete of the attempts at radical cure, we now come to what may be considered one of the boldest innovations of modern surgery,—*the practice of complete extirpation.* This method has the advantage over all others, that it holds out the hope of permanent cure without any danger of relapse, and that also it is equally well adapted to the mutilocular as to the single cysts. In the majority of successful cases it has the further merit of causing to the patient remarkably little suffering. I think it may also be alleged in its favor that should an error have been made in diagnosis, less risk is run in an attempt at extirpation than would be by any one of the other radical methods. The large amount of immediate risk to life which attends this formidable operation is its one great drawback. Few practical questions have occupied more of the attention of the profession, both at home and abroad, during the last twenty years than this: whether the immediate risks of ovariotomy outweigh its advantages. Although many details as to modes of operating, etc., still remain to be decided, yet the verdict on the main question may be said to be given. The discussion has been carried on most openly; facts and statistics have been scrutinized most keenly; and the result is that ovariotomy is becoming more and more common; that it has recently been practised in almost every hospital in London, while it is gradually extending both in America and on the Continent. Simultaneously with the increased favor which ovariotomy has gained, the other methods of radical cure have fallen into comparative disuse. I shall not occupy space here with any attempt to enter into this discussion, but, venturing to assume that the operation does not now need any defence, shall proceed at once to consider the important practical details of its performance. First, let it be remarked that no impression can be more false than that the extirpation of an ovarian tumor is a procedure requiring but little surgical skill or forethought, and making demands only upon the surgeon's courage, or, it may be, in the estimation of some, his recklessness. Perhaps there is no operation in surgery presenting greater scope for ingenuity, and requiring more prompt attention to numerous details in its performance.

The operation.—In preparation for ovariotomy, the surgeon should be provided, in addition to scalpels, director, etc., with at least two large trocars, one of them armed with an India-rubber tube, two or three strong vulsellum forceps, two clamps, and actual cautery instruments, some gilt harelip-pins or silver-wire sutures, and strong hemp ligatures. Some strips of new flannel, and several large, unused

sponges, made soft by scalding, should also be at hand. The operation should be performed in the room where the patient is to remain, and it should be a large and well-ventilated one. If the weather be not hot, the temperature of the room should be raised to 70° or 75°, and the air moistened with steam. With regard to special preparation of the patient nothing is needful beyond the ascertaining that her bowels have been opened on the previous day, and that she is in usual health. It

Fig. 551.



Trocar armed with tubing, for use in ovariotomy.

is especially desirable to abstain from disturbing her stomach by the previous administration of useless drugs. As the operation may be prolonged, she should be warmly clad on those parts which it will not be requisite to expose, and precautions should be taken to prevent her dress from being wetted by the fluid. Chloroform [or ether] having been administered, an assistant should introduce a catheter and empty the bladder. The patient should be placed on her back, with her shoulders elevated by pillows, her feet resting on a chair, and the abdomen well exposed. The operator now commences his incision about two inches below the umbilicus, and carries it downwards in the median line about four inches. With a few touches of the knife, and using the director or not, as may seem best to him, he rapidly divides the fascia and lays bare the peritoneum. There is scarcely any bleeding if the median line be carefully kept to. The peritoneum having been opened to nearly the full extent of the wound, the cyst itself is exposed, and at the same time in many cases a certain amount of ascitic fluid escapes. The next step is to ascertain whether or not adhesions are present. This in many cases is evident to the eye; but if not, is easily determined by introducing one or two fingers between the cyst and the peritoneum. It is needful at this point to be exceedingly careful not to mistake the peritoneum itself for the cyst-wall, and thus carry the finger between it and the transversalis fascia—an error which has, to my knowledge, occurred several times, and to different operators. If adhesions exist, they must be cautiously broken down, and for this purpose it may be necessary to introduce the entire hand. [The majority of operators use a male urethral sound, No. 10 or 12, to detect adhesions, and to separate them, when that is possible, by moderate force. The stronger adhesions, which do not give way, as the sound is swept round between the abdominal walls and the viscera, are more conveniently treated after the cyst is emptied.] For several reasons it is very desirable to break down all the adhesions, as far as practicable, before tapping the cyst. Whilst the cyst is full, it supports the parietal peritoneum, and prevents risk of its detachment by the traction necessary to tear them through: its pressure also diminishes the risk of bleeding. The operator—having ascertained that the cyst has no adhesion in front, or the adhesions, if present, having been broken through—next introduces a large trocar into the most prominent part of the cyst. At this juncture it is well to turn the patient partly on her side, unless a tube-armed canula be used. The best recipient for the fluid is a large glass funnel, fitted with India-rubber tubing. As the fluid escapes, the patient should be turned more and more over to her side, and her abdomen should be carefully compressed by assistants. When the tumor is three parts emptied, the operator may seize it with a vulsellum, and drag it forward carefully, at the same time attending to the trocar, that no fluid is allowed to run back on the wound. As the remaining fluid escapes, the cyst is gradually drawn out until it is wholly delivered; at which juncture the assistants should at once turn the patient again upon her back. A piece of flannel, from warm water, is now placed over the wound, the edges of which are held closely together by an assistant. The operator examines the pedicle, and determines as to the means by which to secure it: either the clamp or the ligature having been firmly applied, the bulk of the tumor is next cut away. It is well to cut it through at a distance of two or three inches from the seat of ligature, as by this means an effectual safeguard against slipping, and subsequent hemorrhage, is obtained. With as little delay as possible, the external wound should now be closed; the surgeon having, however, previously, with his finger, ascertained the state of the other ovary. The wound may be closed either with harelip-pins or by strong wire sutures, and these may be introduced either through the entire abdominal wall, in-

cluding the peritoneum, or through its whole thickness, with the exception of the latter. They should be an inch and a half from the edge of the incision on each side, so as to have a firm grasp. They should not be more than three-quarters of an inch apart, and great care should be taken to carry the lowest as close as possible to the peduncle, or it may be well even to transfix the latter. Should the clamp be used, its handles are now to be removed, the portion of peduncle left on it is to be wrapped in lint, and the ends of the pins and those of the clamp are to be padded with lint. A large mass of cotton-wool may now be placed over the abdomen, and a four-tailed flannel bandage firmly applied over all. The patient should be returned to a warmed bed, and a suppository of two grains of opium may be introduced into the rectum. As a general rule, there will be no need for the administration of stimulants; but should the patient be faint, a little brandy may be given as an enema.

The *after-treatment* must vary according to the special symptoms which may present themselves; but we may venture to offer a few general suggestions. 1st. It is very desirable, in order to avoid vomiting, that the patient should take nothing by the mouth during the first twelve hours excepting a little ice; above all, no opium or other medicine should be so given. 2d. There is reason to believe that the chance of recovery in many cases has been much diminished by the too hasty, and too free, resort to opium and stimulants. The surgeon should watch carefully, and give or withhold these remedies as the patient's state may demand. In not a few cases neither the one nor the other will be necessary. 3d. If the patient be low, she should be nourished by enemata of milk, or beef-tea, to which, if needful, wine or brandy may be added. 4th. If the stomach remain irritable for some days, it is desirable, as long as such is the case, to continue the use of enemata instead of giving food by the mouth. 5th. It can scarcely be needful to insist that there should be a plentiful supply of fresh air to the sick-room.

Traumatic peritonitis is, without doubt, the chief cause of death after ovariotomy. It may commence within a few hours of the operation, and many patients sink from the shock of its initial stage. Many of the deaths attributed to "exhaustion" have, in all probability, been really due to commencing peritonitis. In those cases which wholly escape peritonitis, the recovery is usually most rapid; the patient, in fact, scarcely experiencing a single ill symptom. The earliest *signs* of peritonitis are pricking and shooting pain in the abdomen, a peculiar pallor of the cheeks,[1] and an anxious expression of countenance, with frontal headache. The pulse becomes quicker and smaller, the skin hot, the tongue a little dry, and there is almost always more or less of sickness. Sometimes the patient scarcely complains of pain, excepting what is caused by the shake of vomiting. At a later stage the face may become flushed, and the skin pungently hot, whilst at the same time the pulse is rapid and very small. The concurrence of a very hot and dry skin, with a thready, scarcely perceptible pulse, may be observed now and then in severe cases, and is a sign of most evil omen. Distension of the stomach with flatus is a common and distressing symptom, and at a later stage the intestines also become involved, and the abdomen is full and tympanitic. Peritonitis, after ovariotomy, may be either local or general. If it extend no further than the parts immediately adjacent to the pedicle and wound, it is protective rather than otherwise, since it tends to exclude irritating matters from the general cavity. In cases, however, in which the peritonitis is encysted, and involves but a small part of the sac, very profuse discharge may yet take place, and the patient may sink ultimately from exhaustion. If, in the first instance, the whole sac be involved, it is, I suspect, very unusual for any other than a rapidly fatal event to ensue. The *treatment* of peritonitis will be local and general. Locally it is well in the first instance, indeed as early as possible, to apply leeches freely, and these may be followed by a large hot poultice. The relief afforded by a large linseed poultice covering the whole abdomen is often very decided. On the other hand, the application of ice has its advocates, and it would not be difficult to explain how both heat and cold may each be beneficial. Venesection may, in certain sthenic cases, be resorted to with advantage. Opinions differ widely as to whether mercury is of benefit in traumatic inflammations; my own impression is very decidedly in its favor; and in early stages of

[1] In florid patients, the face may from the first be flushed instead of pale, but I feel sure that the pallor is its most frequent condition. In some of the most severe cases of traumatic peritonitis which I have seen, the patient looked in the early stage as pale as if she had been profusely bled. I have not mentioned rigors as an early symptom. Many cases of peritonitis set in without any marked shivering fit; sometimes a slight feeling of faintness, which rapidly passes off, and then returns again, appears to take the place of a true rigor. Later in the case, after the peritonitis is well established, occasional shivering is rarely absent, but, at the same time, it is not often severe.

the disease I should be inclined to push it freely, in combination with full doses of opium. The practice, too often pursued, of pouring in stimulants, is not, I think, one to be recommended, either on theoretic or clinical grounds; but the patient must be most carefully watched, for remedies of this class will undoubtedly become necessary at a subsequent period. [Careful attention to drainage is important not only for the prevention of peritonitis, but also as a means of treating it. Opium is one of the most reliable agents in this as in all other forms of peritonitis. When the temperature rises so high as to be in itself dangerous, it should be reduced by cold applied according to the method of Dr. G. W. Kibbee.[1]]

With regard to the management of the wound, the following hints may be given. The portion of pedicle or of cyst left above the clamp should be cut close away on the day following the operation, as there will then be no risk of slipping, and it is very desirable to avoid fetor. The clamp itself may be removed on the second or third day. The hare-lip pins should be left to the fourth or fifth; and when they are removed, the greatest possible care should be taken to support the abdomen and wound by long and broad strips of plaster, and the firm application of the flannel bandage. [When the clamp is used, it is perhaps best to leave it on until that portion of the pedicle held in its grasp separates from the living tissues. It is safer to leave the sutures in the abdominal wound for a week at least. Silver wire being generally used now, the sutures do no harm, but great injury may result if they are removed before union is firmly established. I have seen one patient lost by the removal of the sutures on the fourth day.]

In a successful case of ovariotomy the patient will often be able on the second day, or it may be even on the first, to take food by the stomach without risk. In not a few the progress of recovery is as rapid as it usually is after a favorable child-birth; and the patient may be able to leave her bed on the tenth day, or from that to a fortnight or three weeks. If, however, suppurative peritonitis have occurred, the convalescence will be much delayed. There will probably be profuse discharge from the wound; and to secure the escape of this, it will be needful to turn the patient on her side at the time of each dressing. In such cases the patient is fortunate if she be able to leave her bed at the end of a month or six weeks. In most cases in which the peduncle is left in the abdomen, more or less of suppuration from within must be expected. In those in which the opposite practice is adopted the wound usually heals by first intention.

Having thus sketched briefly the course of an ordinary operation, and the after-management of the patient, there yet remain certain occasional difficulties and certain moot questions of treatment which demand more detailed consideration. To take them seriatim.

Is the long or short incision preferable?—There has been much confusion in the description of cases as to which should be assigned to one or the other category. The distinction is purely arbitrary. Should the incision be measured before the removal of the tumor or afterwards? for one which would be considered long whilst the abdominal walls were distended might count as short when they had collapsed. Experienced ovariotomists are, I think, all agreed that a few inches more or less in the length of the wound do not constitute an important element in the chance of recovery. All will also admit that it is far better to enlarge the incision than to lose much time in futile endeavors to extract a multilocular tumor through a small one. On the other hand, no one will contend that a patient has any better chance on account of a large incision. We come, then, to the conclusion that the first incision should be of medium extent, and that the surgeon should be prepared to enlarge it if needful. [By following the method already given for the removal of multilocular tumors the medium incision is the longest that is required. It is important to keep this in mind, because experience shows that the higher the incision extends the greater is the danger of this part of the operation.] About four inches, or just large enough to admit the knuckles, is perhaps a fair average measure; but in a few cases, in which there may be good reason to believe that the cyst is single, a much smaller one may be tried.

Adhesions.—I have already insisted on the importance of detaching adhesions as much as possible before the fluid is evacuated. For this purpose, if the adhesions are extensive, it is usually necessary to introduce the whole hand, and, carrying it between the peritoneum and cyst, by a lateral movement, break through all connecting bands. Not unfrequently however, the more important adhesions are found behind the cyst, uniting it to the viscera, or to the lumbar or pelvic peritoneum. These cannot, as a rule, be reached until the cyst has been partially emptied. In separating these, great care must be taken not to drag too forcibly on the peritoneum. Not only may injury be done by tearing up the serous membrane

[1] See Thomas on the Diseases of Women, pp. 752–3.]

from its attachments, but lacerations of viscera or of large vessels may occur. The movement employed should still be as much by a lateral sweep, and as little by direct pulling, as possible. The peritoneum should be supported by the other hand, or by other fingers of the same. It is better, under all circumstances, to tear rather than cut; but when important viscera are involved, such as the intestines or gall-bladder, it may become needful to resort to a careful dissection.

That the existence of adhesions to a moderate extent does not materially prejudice the patient's prospect is generally admitted. There seems to be less danger of acute diffuse peritonitis in such cases than in those in which the integrity of the serous sac has never before been interfered with. On the other hand, adhesions prolong the operation and cause risk of hemorrhage, and in these respects are prejudicial. If very extensive or very strong, they may constitute a serious complication.

Adhesions to the omentum are very frequent, but are for the most part easily dealt with. If very vascular, the omentum may be tied, and the end brought out into the wound. Dr. John Clay has devised an "adhesion-clamp" for holding bands of adhesion whilst they are cauterized or rubbed through, etc.

A special difficulty caused by adhesions in front.—In cases in which adhesions to the parietal peritoneum at the place of incision are intimate, great difficulty may occur in distinguishing the cyst. The operator may mistake the cellular interspace between the transversalis fascia and the parietal peritoneum for that between the cyst and the latter, and proceed to break down the connecting tissue. This error, although hitherto little if at all mentioned, has repeatedly occurred; and it is one which, if not very quickly discovered, may lead to great damage. On the other hand, the surgeon may, in his anxiety to avoid this, commit another. He may incise the visceral peritoneum of the cyst, and proceed to separate it. This error is less serious than the other, but it may cause great difficulty and much loss of time. In many cases the exterior of the cyst, deprived of its peritoneum, is smooth, white, and glistening; the adhesions are cellular, and easily broken through; so that there is nothing whatever to apprise the operator of his mistake. I know of but one plan by which, in case of perplexity, to avoid at once all risk of these two errors; and it is this:

Fig. 552.

Clay's adhesion-clamp.

to enlarge the wound upwards until the peritoneal cavity is opened at a part where no adhesions exist. When once the operator's finger has touched intestine, he knows where he is, and may proceed to detach adhesions without any chance of mistake.

Multilocular cysts.—The operator should always be provided with at least two trocars, so that he may, if needful, puncture any second cyst which may present itself. If the cysts be very numerous and many of them of considerable size it may greatly expedite the operation to cut freely into the largest with a scalpel, and then introduce the hand into the interior, and break down their dissepiments. Of course before this is done the cyst should have been partially withdrawn and secured, and the patient placed well over on her side. Or, instead of making a large incision into any one of them, the tumor may be dragged forwards, and each single one punctured individually as they appear in the wound.

Prevention of escape of cyst-fluid into the abdominal cavity.—This is of very great importance. No single precaution is, I am convinced, more effectual in securing it than that of turning the patient over on her side. By this means a depending opening is given by which the fluid may escape, and the chance of its gaining access to the peritoneum is very greatly lessened.[1] The patient should be turned over to that side on which the intestines are supposed to lie, *i. e.*, with that side uppermost from which the tumor is believed to originate. During the removal of the tumor, an assistant should most carefully keep the edges of the wound pressed together, and, after its completion, a piece of flannel should be at once

[1] Mr. Spencer Wells has devised an ingenious and, I believe, very useful appendage to the ordinary canula, by which the slipping of the cyst is prevented. It consists of toothed springs, which clamp the cyst firmly to the sides of the canula.

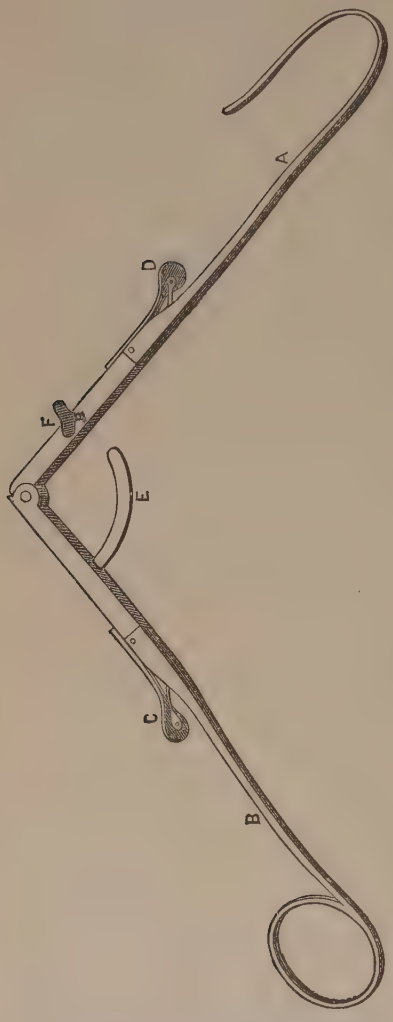
carried over the wound, beneath the cyst. If by any chance cyst-fluid have escaped into the peritoneum, it is doubtful practice to do much in attempting to remove it. A piece of soft scalded sponge is better for the purpose than flannel; but too much painstaking in this matter would probably cause more danger than it would prevent.

[Although contrary to the above statement, it is of the greatest importance thoroughly to cleanse the abdominal cavity of cystic fluid and blood by the most complete sponging. It is recognized as a fact beyond all question, that to leave anything which is liable to decompose in the peritoneal cavity, is one of the greatest sources of danger in ovariotomy. Furthermore, all hemorrhage caused by separating adhesions should be arrested by ligating the bleeding vessels, and by the use of styptics, such as liq. ferri persulphatis. After all possible care has been taken to cleanse the cavity, if some oozing still remains, provision should be made for free drainage. That is best accomplished by passing Thomas's glass drainage tube down to the bottom of the sac of Douglas, and securing the upper end of it in the torn angle of the abdominal wound.]

Management of the peduncle.—The operator has his choice of numerous different methods of securing the peduncle, each of which has its advantages and its drawbacks. 1st. He may tie it with a hemp or a strong silk ligature, either in one piece or by transfixion in two or more parts; and then, having cut away the tumor, allow the stump to slip back into the abdomen, the ends of the ligatures being brought out at the wound. The advantages of this method are, that there is no traction on the peduncle, and by leaving the ligatures on, they secure an open channel for the escape of pus, and also allow of their safe removal when loose. Its disadvantages are, that the sloughy stump of the peduncle with its attached ligatures returned into the peritoneal sac are very likely to set up peritonitis. 2d. The peduncle may be tied as in the first method; and then, the ligatures having been cut close off, the whole may be returned, and the abdominal wound closed. In this plan it is hoped that the external wound will heal, and the portions of ligature left in the peritoneum become encysted, and cause no irritation. Nothing but the large amount of success which has recently followed the adoption of this most unsurgical method appears to me to justify it. Its disadvantages as regards the probability of peritonitis, and the risk of hemorrhage from slipping of the ligature (it being part of the plan to cut the peduncle close to the ligature) are evident. 3d. The peduncle may be divided by the écraseur or by the actual cautery. The time necessarily employed in dividing the peduncle, and the risk that intra-abdominal hemorrhage may subsequently occur, are the drawbacks to this plan. The first might probably count for little; but the latter, especially in the case of a thick vascular peduncle, is most grave. Its advantages are, that it entirely obviates the dangers incident to dragging on the peduncle, and at the same time leaves neither sloughy tissue nor ligatures in the peritoneal sac. In all the preceding methods the stump is returned into the abdomen under circumstances more or less unfavorable as regards the risk of its causing peritonitis. We now come to the plan which may probably be considered as one of the chief modern improvements made in the operation. I allude, of course, to the principle of endeavoring to keep the end of the peduncle altogether out of the abdomen. This principle may be carried out either by the use of ligatures (hemp, silk, or metal), or by resort to a metal clamp. The latter instrument has the advantages that it can be applied easily and speedily, and with greater security as regards hemorrhage. Various modifications in form have been proposed by different operators; but the most simple, and, I believe, the best, is one which resembles a pair of carpenter's callipers, but from which the handles are removable. It should be pressed tight with great force, and the screw by which it is fixed should be screwed down with the assistance of forceps to prevent all possibility of slipping. It is a good precaution to push two or three needles through the peduncle above the blades of the clamp, and an absolutely essential one to cut off the tumor at a considerable distance above it. In cases in which the peduncle is long and slender, the action of the clamp is most satisfactory, and no inconvenience whatever results from its use. In those, on the contrary, in which the peduncle is short, and still more in those in which a peduncle can scarcely be said to exist—the base of the tumor itself occupying the entire expansion of the broad ligament,—the application of a clamp is difficult and inconvenient, and very hurtful traction on the uterus and pelvic peritoneum will be caused. The amount of traction may, in very thin patients, be not great at the time of the operation; but it will increase afterwards, should the abdomen become distended. How best to manage short peduncles is still one of the problems of the ovariotomist. In some cases it may be practicable, after the tumor has been cut away, and when, in all probability, the mass left on above the clamp has considerably shrunk, to reap-

ply the clamp somewhat higher up. In order to effect this to best advantage, the operator should be provided with two

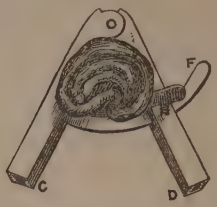
Fig. 553.



The calliper-clamp open, and with its handles attached. A and B the handles, C and D the spring catches by which the handles are fixed, E the curved rod which traverses the handle A when the instrument is closed and is secured by the screw F.

clamps of similar size and make. One of these may be applied above the other, the screw having been, of course, removed from the lower one, and its handles being simply held together by an assistant. The lower clamp having been removed, the process may, if practicable, be repeated, and in this way an inch, or an inch and a half, might easily be gained in the length of the peduncle. It is true that part of the peduncle to be left in the wound will have been somewhat contused; but probably not so much as to endanger its vitality, or cause it to become a source of irritation. It may be borne in mind also

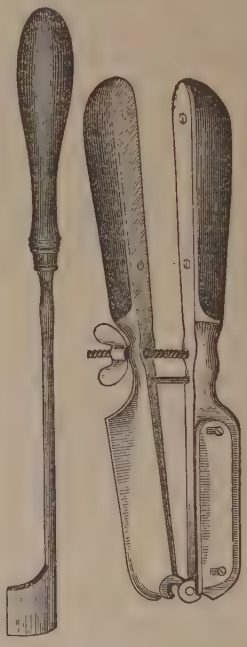
Fig. 554.



The clamp in position, the tumor having been cut away, and the handles of the instrument removed. For convenience in showing the outline of the instrument, the cyst has been represented cut away almost close above it. This in practice ought never to be done; but a considerable mass should be left above the clamp to prevent risk of slipping.

that this portion will, should the abdominal parietes be thick, come in contact rather with the edges of the wound than with the peritoneum.

Fig. 555.



Clamp and cautery iron for cautery-section of the pedicle in ovariotomy. The blades of the clamp are partly of wood and in part of metal.

On the whole, I think that the operator will do well to determine to use the clamp in all cases in which the peduncle is long enough; in cases in which it is too short it will be better when practicable to employ ligatures, and to let the peduncle sink into the wound so that the seat of ligature is level with the peritoneum;

and lastly, in cases of extreme shortness he should use the actual cautery. In spite of recorded successes, I cannot but feel a strong prejudice against cutting ligatures and pedunclcs off short, and dropping the stump into the abdomen. This incurs the risk both of hemorrhage and peritonitis.

[The three methods of treating the pedicle, described above, are still practised at the present time. Each, no doubt has advantages, in certain cases, hence it would be unwise to accept any one method to the exclusion of the others. The experience of the last ten years has increased the confidence of operators in cautery, section, and the ligature.

Dr. Keith, the most successful of all ovariotomists, employs the cautery in the majority of his cases.]

Closing of the external wound.—This is an easy matter, and may be done with equal facility either by harelip-pins or silver wire. If pins are used they must be gilt or silvered, not plain steel. The practice of Mr. Spencer Wells has proved that it is safe to pass the needles through the peritoneum; but it may be doubted if any material advantage is obtained. If not through the peritoneum, the ligature or pin should pass close to it through everything else. It is always well to transfix the pedunclc, and thus secure it firmly in the wound.

Why has ovariotomy been appreciated more highly of late years than formerly?—The new method of keeping the end of the pedunclc outside the abdomen is, I believe, the chief improvement of recent times. No doubt something has been done in the introduction of more cautious after treatment, especially in the comparative disuse of opium. But chief amongst the reasons of the advance of ovariotomy in general favor is, *that it has been largely and openly tried.* Even in reference to the improvement in keeping the end of the pedunclc out of the abdomen, if we put confidence in statistics, we must admit that those of Dr. Clay and Mr. Walne, who did not adopt it, are at least as good as those of other operators.[1] Even at the present time ovariotomy, as practised in isolated cases, and especially in the large hospitals, is attended by a very great fatality. It is only in the hands of those who have had considerable experience of its details that its ratio of mortality begins to improve. The reason why the mortality in our large hospitals appears to have been so high is in part explainable by what has just been hinted at, and in part by the fact that all such cases are made public, whilst a large majority of the unsuccessful cases occurring in private are not so. But after all allowance has been made on these heads, it still remains not improbable that the hospital air—germ-laden perhaps—which comes in contact with the peritoneum and wound during the operation, has something to do with the production of peritonitis.

[The success of ovariotomy at the present time, which contrasts so favorably with that of ten years ago, is due to many improvements in the knowledge of ovarian disease and in the details of surgical treatment, as shown in more accurate diagnosis, by which cases unfit for ovariotomy are rejected, in better methods of managing adhesions and arresting hemorrhage, in a careful selection of the appropriate treatment of the pedicle in individual cases, in thorough drainage when required, and perhaps above all in the employment of antiseptic measures during the operation and in after treatment.]

What may the average success of ovariotomy be expected to be?—Those who allege that many fatal cases have been kept back, and that consequently statistics on this question are not trustworthy, have no doubt a certain amount of truth in support of their assertions. During the last fifteen years several operators have, however, publicly undertaken to disclose their whole experience; and there is, I think, no doubt that they have most creditably done so. From their statistics we gather that two recoveries to one death is a proportion which, in practised hands, may be confidently expected, and that perhaps we may even very considerably improve on this. Dr. Clay's table of cases from all sources gives us 212 recoveries to 183 deaths; and, making allowance for unpublished cases, I fear we cannot hope that the gross mortality of the past has been less than one-half. In reference to all operations, and especially to these, the practical surgeon may most properly insist that deductions from general statistics are not to be applied too rigidly to individual cases. In many instances ovariotomy has been performed as a last resource, after the patient's powers had given way, and when the prospect of a favorable issue was very slight indeed. Now that the operation is fairly established in public confidence, we may expect that a considerable improvement in general results will follow, from the circumstance that a larger number of cases will be submitted to it at early periods of the disease. Although the results, even in many unhopeful cases, have been such that the ovariotomist scarcely feels justified in positively refusing to ope-

[1] Those of Dr. Tyler Smith, whose practice it has been to cut off the ligatures short and return the whole, are perhaps the best yet obtained. They are, however, only limited in number.

rate in any, yet there can be no doubt that it would be easy to select a certain number in which, if the credit of surgery is to be had in account, it would be wiser to decline it. Such are cases in which there is a history of severe attacks of peritonitis at some distant time; cases in which the tumor has existed for unusually long periods; and cases in which tapping has been very frequently performed, and the patient's strength has been greatly undermined. In the following remarks on the advantages accruing from the operation, as established by reference to arithmetic, I have, as will be seen, taken the lowest estimate of success, and in several other respects I have given the operation a less favorable position than it may, I believe, legitimately claim.

Remarks on the advantages of ovariotomy, as shown by statistics.—To compare its results with those of lithotomy, amputation, etc., is very much beside the mark, since operations performed with such differing objects, and under such different circumstances, afford no fair comparison. Each one must be considered on its own merits. The test I would propose is this: Let it be admitted that the object of surgery is the increase of the sum of human life, and the lessening of its disabilities and miseries. Whether this life is enjoyed by many individuals over short periods, or by few over long ones, is not of moment, if the sum of it be increased. If, then, we have 100 patients suffering from ovarian disease, and there is a fair probability that if all submit to ovariotomy, one-half will recover from the operation and be restored to perfect and, *quoad* the disease, permanent health, the calculation to be made will be simply a comparison of the sum of years which the 100 would have realized if not operated on, with that which the 50 recovered patients might be expected to attain. The ovariotomist, can, I think, well afford to leave out of question the not unimportant factor, that the 100 would have been sufferers, many of them in an extreme degree, throughout the entire remainder of their lives; whilst the 50 would have been in the enjoyment, for the most part, of excellent health. Of 100 patients suffering from ovarian dropsy, in the stage in which such cases usually come under care with a view to the operation, it is exceedingly probable that for half of them twelve months would be the limit of life; 25 others might perhaps be expected to die within two years; and the remaining 25 would probably follow at various periods within ten years. If, therefore, we allow three years and a half as the average expectation of life to the whole, it will, I think, be admitted that it is a liberal calculation, and probably much higher than any surgeon would advise an insurance office to accept them at. The average age at which women submit to ovariotomy is 35, and the average expectation of life at this age is 30 years. The 50 patients who recovered might, therefore, expect to enjoy a total of 1500 years of health, which compares very favorably with the 350 years of illness which the whole 100 would have had to endure, if not operated on. If it be objected, that it is not just to one person to deprive her of four years of life in order that another may live 30, the reply is, that this is a matter for the patient to consider, and not the surgeon. It is part of the general lottery of life, and each patient takes her chance of a small loss or a large gain. All that the honest surgeon is responsible for is, that the prizes which he offers to the competition of his clients shall be *bona fide*, and in sum of value far exceeding the deposits which he exacts.

The only source of fallacy which I can see in this argument is the possibility that a few of the cures might not be permanent. Either the other ovary might be attacked, or cancer might be developed in some other organ. To this it may be replied, that experience has fully proved that in almost all cases the cures after ovariotomy are genuine and permanent. The exceptions to this have been exceedingly rare.

Errors in diagnosis.—The principal mistakes which have occurred have been in respect—1st, to solid, or partially solid, uterine tumors; 2d, to phantom tumors; 3d, to pregnancy; 4th, to ascites; 5th, to hydatid cysts; 6th, to colloid disease of the peritoneum; and, 7th, to cysts in the broad ligament. One general remark may be ventured in reference to them all, and it is this, that the surgeon should place no trust in the patient's statements, but should, before undertaking any radical operation, carefully examine his patient by all practicable methods. A vaginal examination ought not to be omitted (unless the case is clear beyond a doubt), since in the very cases in which the surgeon may feel most inclined to omit it (those, namely, of single women), it is the most likely that a misleading history may have been given. Keeping in mind that ovarian tumors ought to be perfectly dull in front, and should leave a tympanitic space in one or in both lumbar regions, there will rarely be much difficulty as regards ascites or phantom tumors. Should any doubt be felt, changes of the patient's position, and re-examination by percussion, will generally clear it up in respect to the former; and the exhibition of chloroform[or ether] in regard to the latter. I am not aware that any radical operation has ever been attempted in a case which

proved to be one of simple pregnancy; but as in not a few such paracentesis has been resorted to, we must always bear in mind the possibility of that error. In two or three cases of ovarian dropsy, complicated by existing but unrecognized pregnancy, ovariotomy has been performed, and in one at least with success. Provided the uterus is not interfered with, this is, perhaps, not a very dangerous blunder. The power which pregnant women possess of resisting severe injuries is remarkable. The differential diagnosis between uterine and ovarian tumors is by very far the most difficult of those under consideration, and under some circumstances may be impossible. The history of uterine hemorrhage, the slower growth, the greater solidity,[1] more or less of fixation to the uterus, are symptoms by which those of uterine origin may usually be known. If there is doubt, it will be well to wait; for, provided the uterine tumor be innocent, it will not attain any enormous size, and may not improbably begin to diminish after a time.

Whilst an ovarian tumor is small, and especially in a fat abdomen, the establishment of a positive diagnosis may often be attended with insuperable difficulties. In cases, however, in which an operation is legitimately in question, the difficulties will usually have disappeared with the increase in size of the cyst. In cases of "phantom tumor" especially, the surgeon may, not unfrequently, feel unable to assert the negative as to ovarian dropsy; but if he is satisfied that there is a clear percussion-note over any considerable extent of the front of the abdomen, he will of course decline to entertain the question of an operation. The usefulness of chloroform inhalation in affording facilities for clearing up these cases cannot be overrated.

XII. Fistulæ communicating with the Vagina or Uterus.

Fistulous openings may exist: 1st, between the urethra and vagina; 2d, between the bladder and vagina; 3d, between the bladder and uterus; 4th, between the vagina and rectum. In certain cases a common communication may open bladder, vagina, and rectum into one. We shall omit here all consideration of openings caused by the extension of cancerous ulceration, since they are quite beyond surgical treatment. The various forms of simple fistulæ usually result either from contusions or lacerations in parturition, from the introduction of foreign bodies, or from the effects of calculous concretions in the bladder, or operations for their removal.

The inconvenience caused by any communication between the *bladder* and adjacent cavities is extreme, since it is usually attended by constant incontinence of urine. A large opening may, however, exist between the *rectum* and vagina without exposing the patient to much annoyance, since in many cases the involuntary escape of feces occurs only when the motions are unusually fluid. So great and so general has been the success obtained by operators in the cure of most of these forms of fistula, that it is scarcely worth while to occupy space by reference to less efficient modes of relief. It is admitted on all hands that, although by the use of the actual cautery small fistulæ may be much diminished, yet that they can very rarely indeed be made wholly to close, and the after-treatment in these cases is just as irksome as in those of operation. On the other hand, the results obtained by Dr. Bozeman, Mr. Brown, Mr. Bryant, Dr. Marion Sims, the late Sir James Y. Simpson, and Mr. Spencer Wells, have been so exceedingly satisfactory that we may fairly rank the operative cure of these distressing conditions as a finished achievement.

Considering the want of success which attended the attempts of the earlier surgeons, some of whom (especially Dieffenbach) devoted attention very perseveringly to the subject, it suggests itself as a most interesting question in practice, to what precise improvements have recent results been due? Speaking chiefly of vesical fistulæ, I think we may mention the following as among the chief: 1st, the use of chloroform [or ether], which enables the operator to proceed with much increased facility in the difficult steps of the dissection; 2d, the use of metal sutures instead of silk; 3d, the avoidance of the vesical mucous membrane, both in the dissection and in the application of the sutures; and, lastly, increased attention to keeping the bladder empty afterwards. A few years ago much reliance was placed on metallic or wire shields, adjusted over the line of union; but these are now generally discarded, and reliance placed on sutures alone.

[1] Uterine fibroids not unfrequently soften in the centre, and present the symptom of fluctuation, more or less clearly marked. They often attain a size sufficient to distend the abdomen, as at the period of advanced pregnancy. On three different occasions patients have been sent to me with a view to the performance of ovariotomy, when, on careful examination, I satisfied both myself and others that the tumor in question was in reality uterine. In all these, hemorrhages had, at an earlier period, been a prominent symptom.

The following are the steps of the operation in a case of vesico-vaginal fistula: The patient should be in her best state of health, and the bowels should have been well cleared out. Chloroform [or ether] having been given, the woman is placed either on her side, with the knees well drawn up, or in the usual lithotomy position. The parts being well exposed by the duck-bill speculum, and the nates being held widely apart by an assistant, the operator proceeds to drag the opening as low down as possible, with a view to facilitate the paring of the edges. This may be accomplished either by hooks, blunt or sharp; by the use of a metal suture; or by the introduction of a flexible sound by the urethra, which is brought out again through the fistula, and then bent backwards. This latter plan furnishes the surgeon with a most efficient hook, and one which cannot easily slip. In paring the edges, it is necessary thoroughly to denude every part; for if the smallest portion of mucous membrane be left, it may prevent union. None of the mucous membrane of the bladder must be removed. The wound should present a bevelled oblique line, slanting from a large vaginal opening to a smaller vesical one. [The easiest way of vivifying the edges is to seize the tissue in a toothed forceps or an Emmet's tenaculum, and pare it with curved scissors.] The denudation being complete and free, sutures are next to be introduced. These should be passed obliquely from at least a third of an inch outside the edge of the incision. They must not include the mucous membrane of the bladder. The tightening and tying of wire sutures is easily accomplished by the fingers. [The wire sutures should be brought together by gentle traction, aided by pressure on each side where they emerge from the tissues, and then fastened by twisting.] Care must be taken not to pull them too tight, so as to invert the edge of the vaginal mucous membrane. The instruments used in these procedures consist of small knives, forceps, and needles of various construction. Startin's tubular needle for carrying wire is in most cases the best. [Most operators use a small slightly curved needle, about three-quarters of an inch long, without cutting edges. This is armed with a double thread, to the looped end of which the silver wire is fastened by another loop bent upon itself.] Provided the precautions insisted on, as to avoidance of the mucous membrane of the bladder, be observed, it does not appear that there is such great difference in result from wire or silk ligatures as was at one time supposed. Still it is certain that wire is not more [but less] irritating than silk; and as it is at least equally easy to use, it may be considered preferable.

The after-treatment consists chiefly in great attention to keeping the bladder empty. A catheter, either the small silver one introduced by Dr. M. Sims, or a common flexible one, should be retained; and it should be a nurse's duty to see that the urine is constantly flowing. The catheter should be changed and cleaned twice daily; and if at any time the flow of urine stop, it should at once be examined. The patient must lie on her side, with the knees drawn up, and every attention must be paid to sustaining her general health.

The sutures may be left in almost indefinitely; and unless it is clear that the operation has failed, they should certainly not be removed till the ninth or tenth day. If cicatrization has occurred, they will cause no inconvenience; and their retention a few days longer than is absolutely necessary is a matter of no consequence, whilst their premature removal is a very grave error. It is needless to say that their removal should be effected with every precaution.

The nearer the fistula is to the urethra, the more easy is the operation in performance, but the greater is the chance that it may fail. One difficulty in closing urethral fistula arises from the fact that the catheter almost necessarily presses upon the line of union.

In cases in which the fistula is very high up—or it may be even connects the bladder with the cervix uteri—certain modifications in the plan of operation will be required. It may even become desirable to obliterate the upper part of the vagina, and to connect the uterus with the bladder, thus allowing the menstrual fluid to pass per vesicam, but preventing incontinence of urine.

The operation in cases of recto-vaginal fistula does not differ materially from that just described. The paring of the edges must be practised in a similar manner, and care must be taken to avoid the rectal mucous membrane. The bowels must be kept from acting for ten days subsequently, and it may be well also to retain a catheter in the bladder. Whether or not the sphincter ani should be divided will depend upon the degree of tension which is present when the parts are brought together. It is not a slight measure, and should not be needlessly resorted to. In these, as in the preceding cases, the unencumbered suture of twisted wire is better than any form of compress or button, and far better than the shotted one. After the operation the vagina should be washed out by injections of tepid water daily.

XIV. Cæsarian Section.

It would be out of place here to consider any of the questions respecting the cases demanding this formidable operation, but it is desirable to describe its performance. The surgeon must provide himself with scalpels, directors, and forceps, and should have also a large probang armed with sponge. The patient should be placed on her back, with the shoulders and trunk a little elevated. The bladder should be emptied by means of the catheter. Before beginning, a final examination should be made to ascertain whether the bones may not be yielding, for in osteo-malacia the hope of natural delivery should never be abandoned absolutely. The incision through the abdominal wall must be made as in ovariotomy, and should extend from the navel to within two or three inches of the pubes. The uterus having been exposed, it should be held forwards by side pressure on the abdomen, and opened freely by an incision in the middle line. The incision should not involve either the fundus or the cervix. An assistant may now introduce a forefinger of each hand into the upper and lower angles respectively of the wound, and thus hook the organ forwards. After rupturing the membranes, the child is to be seized by the feet and extracted. The hand is next to be introduced between the membranes and the anterior wall, and the placenta is to be detached and removed. If the placenta have been found beneath the wound, it may have been necessary to detach it before removing the child. At this stage, the troublesome part of the operation, the risk of hemorrhage, will be encountered. To restrain bleeding, the uterus should be compressed in the hand, or ice may be used, or under urgent circumstances, the perchloride of iron. Before closing the wound, the surgeon should pass the sponge-probang downwards, through the cervix into the vagina, to clear the passage. All bleeding having ceased, care should be taken to remove any coagula from the uterine cavity, the wound, and the peritoneum. The decision as to the use of sutures to the uterus or not, will depend upon the tendency to gape which may be observed. If there is much gaping, it will be better to put in a few interrupted sutures—Lister's carbolized gut might have advantages—and cut them off short. The wound in the abdominal wall must, lastly, be closed completely, as after ovariotomy.

The after-treatment will consist in the efficient use of ice-bladders to the abdomen, and the internal administration of opium if required. Great care should be exercised in allowing the patient to take food if there is any tendency to sickness. Under such circumstances it will be far better to sustain her strength by enemata.

I cannot forbear the expression of a hope that this operation may not become fashionable with obstetricians. Nothing is more absurd than to compare it with ovariotomy, and to hope that the dangers of the one will be reduced as have been those of the other. It is a most formidable procedure, warrantable only under the most exceptionable circumstances.

[Since Dr. T. G. Thomas has demonstrated that laparo-elytrotomy is, in many cases, vastly superior to Cæsarian section, the hope expressed by Mr. Hutchinson will surely be realized in the future of obstetrical surgery.

Coccyodynia.

This affection was first described as a neuralgia of the coccyx, by Dr. Nott, in the North American Medical Journal, May, 1844, but it attracted little attention until 1861, when Sir James Y. Simpson revived the subject and gave it the name which it now bears.

Pathology.—Pain upon moving the coccyx and contracting the muscles attached to it are the chief characteristics of this disorder. The morbid conditions found are variable. Fracture and dislocation of long standing, and caries of the coccyx, have been discovered in some cases. In others no appreciable lesions can be detected. It is presumed, that in the absence of structural changes of the bone and muscles, the pain may be due to rheumatism of the tendons of the muscles or neuralgia of the nerves distributed to them.

Causes.—Women who have borne children are the most frequent, though not the only sufferers from this disorder.

Injuries sustained in parturition, or blows upon the coccyx, exposure to cold, and diseases of the ovaries and uterus are its chief causes.

Symptoms.—There is no suffering while the patient is at rest, but upon rising, sitting down, or evacuating the bowels, pain over the coccyx is experienced. Sitting is painful in some cases, owing to pressure upon the bone. Any sudden movement is attended with suffering. Some patients are unable to rise from a low seat without assistance.

Diagnosis.—Tenderness upon pressing and moving the coccyx are the chief diagnostic signs. Painful hemorrhoids, fissure of the anus, and spasm of the adjacent muscles, caused by ascarides in the rec-

tum, may be mistaken for this affection, but they can be excluded by physical examination.

Prognosis.—Some cases of coccyodynia are slight, and wear away in time without special treatment, but though the disease may not perceptibly injure the general health of the patient, it is often of such long duration, and occasions so much suffering and inconvenience, that it is necessary to resort to some means of cure.

The surgical methods of treatment are those practised by Prof. Simpson and by Dr. Nott. Neither of them is dangerous, and one or the other of them is certain to give satisfactory results.

By Prof. Simpson's method an ordinary tenotomy knife is inserted at the lowest point of the coccyx, and passed flat between the skin and the cellular tissue till its point reaches the junction of the sacrum and coccyx. Then the knife is turned and withdrawn, making a subcutaneous incision, which entirely severs the muscles over one side of the coccyx. The same operation is repeated on the other side. No hemorrhage is to be feared in subcutaneous operations, unless some large vessel should be cut.

An easier operation, and one more likely to effect a cure, is performed by exposing the coccyx through an external incision, raising the extremity of the bone, and severing the muscles with a pair of scissors. The subcutaneous operation, always difficult, is nearly impossible where the bone is covered with much adipose tissue.

Should the bone itself be diseased, section of the muscles would not effect a cure. In such cases the coccyx must be laid bare, disarticulated by the knife, and amputated, according to the method of Dr. Nott.]

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